

THURSDAY, AUGUST 12, 1875

THE SCIENCE COMMISSION REPORT ON
THE ADVANCEMENT OF SCIENCE

SINCE our last week's issue two Reports of the above Commission have been issued, one of them, the Eighth and Final Report, dealing especially with the Advancement of Science.

We attach so much importance to this branch of the inquiry entrusted to the Commission, that we shall deal with the Eighth Report first; and as the Recommendations which the Commission make and the Considerations which have led up to them have long been anxiously looked for, we shall defer any remarks of our own this week, in order to give the Considerations and Recommendations *in extenso*. The following are the various branches into which the Report is divided:—

1. The Scientific Work carried on by Departments of the Government.
2. The Assistance at present given by the State towards the promotion of Scientific Research.
3. The Assistance which it is desirable the State should give towards that object.
4. The Central Organisation which is best calculated to enable the Government to determine its action in all questions affecting Science.

The general remarks made by the Commission on the evidence adduced on the first three heads are as follows:—

"The great advances in physical science which have been made in this country, and within this century, by such men as Dalton, Davy, and Faraday, without aid from the State; the existence of our numerous learned societies, and the devotion of some few rich individuals to the current work of science, at first sight appear to reduce the limits within which State aid to research is required in this country.

"But whilst we have reason to be proud of the contributions of some great Englishmen to our knowledge of the laws of nature, it must be admitted that at the present day scientific investigation is carried on abroad to an extent and with a completeness of organisation to which this country can offer no parallel. The work done in this country by private individuals, although of great value, is small when compared with that which is needed in the interests of science; and the efforts of the learned societies, not excepting the Royal Society, are directed to the discussion and publication of the scientific facts brought under their notice; these societies do not consider it any part of their corporate functions to undertake or conduct research.

"It will have been seen, from the extracts from the evidence, that amongst the witnesses who have advocated an increase of State assistance are some who have made great sacrifices in time and money in the cause of scientific research.

"But whatever may be the disposition of individuals to conduct researches at their own cost, the advancement of modern science requires investigations and observations extending over areas so large and periods so long that the means and lives of nations are alone commensurate with them.

"Hence the progress of scientific research must in a great degree depend upon the aid of Governments. As a nation we ought to take a share of the current scientific work of the world; much of this work has always been voluntarily undertaken by individuals, and it is not desirable that Government should supersede such efforts; but

it is bound to assume that large portion of the national duty which individuals do not attempt to perform, or cannot satisfactorily accomplish.

"The following considerations have been suggested to us by the heads of evidence relating to (1) Laboratories, (2) Observatories, (3) Meteorology, (4) Tidal Observations, and (5) the Payment of scientific workers.

"1. The first condition of scientific investigation is that there should be collections, laboratories, and observatories accessible to qualified persons. The evidence has shown that at present, for certain branches, these do not exist or are incomplete.

"Moreover, there can be no doubt that the Government service should, to a great extent, contain within itself the means of carrying on investigations specially connected with the departments. Even having regard only to the current wants of the State, additional appliances are necessary.

"Three distinct ways have been suggested in which the State might assist in providing the aids to investigation which are required by private individuals. It has been proposed: first, that competent investigators should receive grants in money enabling them to provide themselves with means for conducting their researches; secondly, that laboratories, designed primarily for the service of the State, and those of Universities and other similar institutions receiving aid from the State, should be placed, under proper conditions, at the disposal of such inquirers; thirdly, that laboratories should be erected by the Government specially designed for the use of private investigators, though of course also available for the service of the State. Wherever the first of these methods can be conveniently and economically adopted, we are disposed to consider that it is the simplest and the best; but it must be remembered that for many researches apparatus of a costly but durable character are among the primary requisites; and that to provide these separately for each investigator would involve a large and unnecessary expenditure. It appears to us that the difficulty thus arising might be adequately met by the adoption of the second of the above suggestions. Our attention has, indeed, been called to the inconveniences which might arise from the admission of independent workers into University or State laboratories. But, notwithstanding this difficulty, we think the experiment is one which ought to be tried, and till it has been tried we should hesitate to recommend the erection by the State, for the especial use of private investigators, of laboratories which would certainly be costly, and might possibly be only imperfectly utilised.

"2. Upon a review of the whole of the evidence relating to the subject of Astronomical Physics, we are of opinion that an observatory for that branch of science should be established by the State. In the study of Solar Physics, continuity of the observations is of the greatest importance; and owing to our variable climate, continuous observations of the sun in this country are subject to peculiar difficulties which should be duly considered in the site for such an observatory. The neighbourhood of London is less favourable to physical observations than many other sites which might be found, and for this reason we should prefer that a physical observatory should be placed elsewhere than at Greenwich. On other grounds, also, we think that the Observatory for Astronomical Physics should be an institution entirely distinct from any of the national observatories for Mathematical Astronomy. The subject of Mathematical Astronomy is vast enough to occupy adequately the whole energies of a director, and it is especially important that Astronomical Physics should have the undivided attention of the head of an observatory, because its methods, which are of very recent invention, are as yet incompletely developed, and because, depending, as they do, on a continual comparison of celestial phenomena with the

results of experiments in the laboratory, they are entirely different from those of Mathematical Astronomy.

"Our opinion as to the desirability of such an institution is confirmed by the example of foreign nations; observatories for astronomical physics being already at work in various parts of Italy, and their immediate erection having been determined on at Berlin and at Paris.

"We venture to express the hope that similar institutions may before long be established in various parts of the British Empire. The regularity of the climatic conditions of India, and the possibility of obtaining there favourable stations at considerable heights, render it especially desirable that arrangements should be made for carrying on physical observations of the sun in that country.

"3. With respect to Meteorology we are of opinion that the operations of the Meteorological Office have been attended with great advantage to science and to the country. The subject of Meteorology is a very vast one, and any scheme for its proper cultivation or extension must comprise—(1) Arrangements for observing and registering meteorological facts; (2) Arrangements for the reduction, discussion, and publication of the observations; (3) Researches undertaken for the purpose of discovering the physical causes of the phenomena observed. The resources placed at the disposal of the Committee are inadequate to cover the whole of this wide field; and, having due regard to all the circumstances of the case, we believe that in selecting certain parts of it, as the objects of their special attention, they have been guided by a sound discretion.

"We are also disposed to consider that although, as we have already said, the Meteorological Committee occupies an anomalous position, no other form of organisation could advantageously have been adopted under the actual conditions. We think, however, that if, as we shall hereinafter recommend, a Ministry of Science should be established, the head of the Meteorological Office should be made responsible to the Minister. We fully concur with the opinion expressed by the witnesses that many branches of meteorology can only be effectually promoted by an organisation having the support of Government; and we would draw especial attention to the consideration that if meteorology is to take rank as a branch of terrestrial physics, the observations must be made at stations widely dispersed over all parts of the earth's surface, and those taken by observers of different nations must be so arranged as to be comparable with one another. It is obvious that the intervention of Government would greatly facilitate the attainment of both these objects.

"We are very unwilling that any scientific observations which can adequately be carried on by individuals or associations of individuals, should be undertaken by a department of the Government. So far as the local interests connected with climatic meteorology suffice to ensure due attention being paid to that branch of science, we should prefer to see it left mainly to scientific societies, any assistance the Government might afford being merely subsidiary. That useful results may be obtained by voluntary effort is evident from the work carried on under the direction of Mr. Glaisher, and from the case of the Scottish Meteorological Society, which has succeeded, with very narrow means, in organising a valuable system of observations on the meteorology of Scotland. It is, however, important that any grants for the promotion of meteorological observations in aid of voluntary efforts should be made on some systematic principle; and the attainment of this object would be furthered by making them subject to the control of a minister, who would be cognisant of all the facts relating to the expenditure of the Government upon meteorology.

"We may point out that the returns furnished by the Scottish Meteorological Society and Mr. Glaisher, are

adopted by the Registrars General, and are recognised by Committees of Parliament in discussions affecting the public health, the supply of water, and other matters of the same kind. The value of observations undertaken, as in this case, by private individuals or voluntary associations, must vary from time to time, according to the efficiency of the persons principally concerned in their superintendence. We feel, therefore, that the question how far it is proper that such observations should receive official sanction, cannot be decided *a priori*, and must be left to the judgment of the responsible Minister for the time being.

"4. With regard to tidal observations, it will be seen that, in the opinion of the witnesses, these have not hitherto been conducted and reduced systematically. Considering the agencies which the Government can employ for the purpose of making these observations, the importance of providing proper superintendence for them, and of securing their reduction, we think it desirable that they should be carried on under Government control. The expense involved would chiefly consist in the establishment at proper points, and verification, of tide gauges, and in the reduction of the observations; these being entrusted to officers of Government already stationed at the ports and on the various coasts of the Empire.

"5. The witnesses have expressed themselves strongly as to the justice and policy of remuneration to investigators for their time and trouble, and the evidence also shows by implication how great must have been the sacrifices of those who without private fortune have hitherto devoted their great talents and their valuable time to such work without any remuneration whatever.

"It has hitherto been a rule in the granting of Government aid to scientific investigators, subject, so far as we have been able to ascertain, to but very few exceptions, that such aid should be limited to what was necessary to meet the expenditure actually incurred on instruments, materials, and assistance.

"To grants made under these conditions we think that considerable extension might be given.

"It is hardly necessary to assert the principle that when scientific work is undertaken at the request of the Government, the State is not only justified in paying, but is under obligation to pay for what is done on its behalf and for its service. But we desire to express our belief that there are many instances of unremunerative research in which the benefit conferred on the nation by those who have voluntarily engaged in it establishes a claim upon the State for compensation for their time and labour. Without such compensation much important work must remain unperformed, because it must be expected that many of the best men will not be in circumstances enabling them to devote long periods of time to unremunerated labour.

"It is a matter of course that State aid shall only be given to investigators whose capacity and industry have been placed beyond a reasonable doubt."

With regard to head IV., the Commissioners make the following general remarks:—

"The functions of the Government with regard to science may be summed up under the three following heads:—

"1. The treatment of the scientific questions incident to the business of the public departments.

"2. The direction of scientific instruction when given under the superintendence or control of the State.

"3. The consideration of all questions involving State aid towards the advancement of science, and of administrative questions arising out of such aid.

"It would be difficult to enumerate exhaustively all the various topics comprehended under these three heads, and it will be sufficient for the purpose of showing how wide

is the field of action of the State in regard to science, if we point out that under one or other of these heads are included all scientific questions affecting the army, the navy, the public health, the mercantile marine, public works, Government scientific establishments; the elementary instruction in science under the department of education in primary schools, in the science classes connected with the Science and Art Department, and in secondary schools so far as they are subject to Government control; the aid which is now given, or which it is desirable should be given, to universities and other bodies not directly connected with the State, for the middle and higher scientific instruction, and the control which the State either does or should exercise over them in virtue of such aid or otherwise; the appointments to all scientific offices in the gift of the Crown; grants to museums and their control by the State; aid to scientific expeditions of every kind; the establishment and direction of State laboratories and observatories; grants in aid of such laboratories not under State direction, and in aid of scientific research; and generally the allotment and control of public funds for similar purposes.

"The majority of the witnesses who have given evidence in relation to this branch of the inquiry, express dissatisfaction with the manner in which questions under the preceding heads are now determined, and either recommend the appointment of a special minister of science or of a minister of science and education.

"In most cases the witnesses recommend that such a minister should, in regard to science, be advised by a council. Others, however, are of opinion that the functions of such a council might be exercised by an administrative staff of the usual kind."

After adducing a mass of evidence with regard to this subject, the establishment of a Ministry and Council of Science, the Commission thus discusses it:—

"We have given careful consideration to this part of the Inquiry entrusted to us; and, in the course of our deliberations we have been led to attach much importance to the facts stated in the first part of our report, which show that the scientific work of the Government is at present carried on by many different departments.

"There is nothing to prevent analogous, if not actually identical, investigations being made in each of these, or to secure to one department an adequate knowledge of the results obtained, and the circumstances under which they were obtained, by another.

"Investigations admitted to be desirable, nay, practical questions, the solution of which is of the greatest importance to the public administration, are stated by the witnesses to be set aside because there is no recognised machinery for dealing with them; while, in other cases, investigations are conducted in such a manner as to involve a needless outlay of time and money, because they were originally planned without consultation with competent men of science.

"Passing to the question of the advancement of science, we have arrived at the conclusion that much has to be done which will require continuous efforts on the part of the administration unless we are content to fall behind other nations in the encouragement which we give to pure science, and, as a consequence, to incur the danger of losing our pre-eminence in regard to its applications.

"These considerations, together with others which have come before us in the course of our inquiry, have impressed upon us the conviction that the creation of a special Ministry dealing with science and with education is a necessity of the public service.

"This Ministry would be occupied (1) with all questions relating to scientific and general education, so far as these come under the notice of government; (2) with all questions incidental to the application of national funds for the advancement of science; and (3) with all scientific

problems in the solution of which the other departments may desire external scientific advice or information. It would also be desirable that the department should receive information as to scientific investigation proposed by other branches of the Government, and record their progress and results.

"It is not within our province to express an opinion as to whether the subject of art should be included among the functions of this department; but we are satisfied that the Minister's attention should not be distracted by any immediate responsibility for affairs which have no connection with science, education, or art.

"We have considered whether the official staff of such a Ministry, however carefully selected, could be expected to deal satisfactorily with all the varied and complicated questions which would come before the department. We have given full weight to the objections which have been raised against the creation of a special council of science, and to the arguments in favour of referring scientific questions to learned societies, or to special committees appointed for the purpose, or to private individuals; but nevertheless we have arrived at the conclusion that an additional organisation is required through which the Minister of Science may obtain advice on questions involving scientific considerations, whether arising in his own department or referred to him by other departments of the Government.

"Such questions have from time to time been referred to the Council of the Royal Society, in which the best scientific knowledge of the time is fairly represented. The Committee chosen by that Council for the administration of the government grant of 1,000*l.* per annum in aid of scientific investigations has performed its work to the satisfaction of the Government, of men of science, and of the public. But if much more is to be done for the advancement of science than at present, and if the Departments in conducting their investigations are to have the benefit of the scientific advice which appears now to be frequently wanting, the Council of the Royal Society, chosen as it is for other purposes, could scarcely be expected to take upon itself functions which, it is true, are not different in kind, but which would involve increased responsibility and the expenditure of additional time and trouble. Moreover, amongst the questions on which the departments would require scientific advice, there would no doubt be many requiring a knowledge of the peculiar exigencies of the public service, which would be more readily understood and solved if some persons in direct relation with the departments formed a part of the body to be consulted. It is obviously of great importance that the council should be so constituted as to possess the confidence of the scientific world, and we believe that this confidence would be extended to a council composed of men of science selected by the Council of the Royal Society, together with representatives of other important scientific societies in the United Kingdom, and a certain number of persons nominated by the Government. We also believe that such a body would deserve and receive the confidence of the Government, and that it would be well qualified to administer grants for the promotion of pure science.

"The general opinion we have expressed as to the proper remuneration of scientific work would be applicable to the members of this Council, but the degree and manner in which the principle should be applied in this instance must be so largely dependent on circumstances that we cannot make any specific recommendation on the subject.

"It would be impossible that the Council should in all cases undertake the direct solution, by itself or even by sub-committees, of the problems submitted to it. In many instances, especially when experimental investigations are required, its duty would be accurately to define the problem to be solved, and to advise the Minister as

to the proper persons to be charged with the investigation.

"We are of opinion that the Council should not have the power of initiating investigations; it should, however, not be precluded, in exceptional cases, from offering to the Minister such suggestions as it may have occasion to make in the public interest.

"We believe that reference to such a council would be found to be so useful and convenient that it would become the usual course in cases of difficulty, but we would not diminish the responsibility or fetter the discretion of any Minister by making such reference obligatory, or by preventing a reference to committees or to individuals chosen by him, whenever that course might appear to him to be more desirable.

Finally the Report concludes with the following "Conclusions and Recommendations" :—

"I. The assistance given by the State for the promotion of scientific research is inadequate, and it does not appear that the concession or refusal of assistance takes place upon sufficiently well-defined principles.

"II. More complete means are urgently required for scientific investigations in connection with certain Government departments; and physical as well as other Laboratories and apparatus for such investigations ought to be provided.

"III. Important classes of phenomena relating to Physical Meteorology, and to Terrestrial and Astronomical Physics, require observations of such a character that they cannot be advantageously carried on otherwise than under the direction of the Government.

"Institutions for the study of such phenomena should be maintained by the Government; and, in particular, an observatory should be founded specially devoted to Astronomical Physics, and an organisation should be established for the more complete observation of tidal phenomena and for the reduction of the observations.

"IV. We have stated in a previous Report that the national collections of Natural History are accessible to private investigators, and that it is desirable that they should be made still more useful for purposes of research than they are at present. We would now express the opinion that corresponding aid ought to be afforded to persons engaged in important physical and chemical investigations; and that whenever practicable such persons should be allowed access, under proper limitations, to such laboratories as may be established or aided by the State.

"V. It has been the practice to restrict grants of money made to private investigators for purposes of research to the expenditure actually incurred by them. We think that such grants might be considerably increased. We are also of opinion that the restriction to which we have referred, however desirable as a general rule, should not be maintained in all cases, but that, under certain circumstances and with proper safeguards, investigators should be remunerated for their time and labour.

"VI. The grant of 1,000*l.*, administered by the Royal Society, has contributed greatly to the promotion of research, and the amount of this grant may with advantage be considerably increased.

"In the case of researches which involve, and are of sufficient importance to deserve, exceptional expenditure, direct grants in addition to the annual grant made to the Royal Society, should be made in aid of the investigations.

"VII. The proper allocation of funds for research; the establishment and extension of laboratories and observatories; and, generally, the advancement of science and the promotion of scientific instruction as an essential part of public education, would be most effectually dealt with by a ministry of science and education. And we consider the creation of such a ministry to be of primary importance.

"VIII. The various departments of the Government have from time to time referred scientific questions to the Council of the Royal Society for its advice; and we believe that the work of a minister of science, even if aided by a well-organised scientific staff, and also the work of the other departments, would be materially assisted if they were able to obtain, in all cases of exceptional importance or difficulty, the advice of a council representing the scientific knowledge of the nation.

"This council should represent the chief scientific bodies in the United Kingdom. With this view its composition need not differ very greatly from that of the present Government Grant Committee of the Royal Society. It might consist of men of science selected by the Council of the Royal Society, together with representatives of other important scientific societies, and a certain number of persons nominated by the Government. We think that the functions at present exercised by the Government Grant Committee might be advantageously transferred to the proposed Council."

HINRICHS' "PRINCIPLES OF CHEMISTRY"

The Principles of Chemistry and Molecular Mechanics.

By Dr. Gustavus Hinrichs, Professor of Physical Science in the State University of Iowa. (Davenport, Iowa, U.S. : Day, Egbert, and Fidler, 1874.)

THIS work constitutes the second volume of a treatise on "The Principles of the Physical Sciences," and its main object is to present theoretical chemistry in its most modern aspect and to discuss its laws from a dynamical point of view. It is divided into two portions: "Molecular Statics," and "Molecular Dynamics." The former commences with an account of chemical atoms, it being premised that the conception of a chemical atom is the basis of the modern chemical theory. Although the author tells us that the chemical atom is a reality, while the philosophic atom is only a possibility, we have a little difficulty in accepting his definition of a chemical atom as "a very minute, relatively indivisible particle of matter." For it is surely unwise to retain a term so precise in its etymological significance if we admit its divisibility. We are told that "an atom of lead sulphide" can be divided into an atom of lead and an atom of sulphur; and further (p. 19), that "the molecule of gaseous compounds consists of one atom of the compound." But a molecule is defined as a "group of atoms" elsewhere, so that it would appear that a molecule is sometimes an atom, and an atom is sometimes a molecule, and such confusion of ideas must be most detrimental to the acquirement of exact knowledge by the student.

It is useless for us to protest against variations in the mode of writing formulæ, for such protestations have been made any time during the last ten years in vain; but we are quite justified in saying that such changes harass the student to an extent to which the authors of them can scarcely be aware. Why should NaCl be written NaCl⁴², and KNO₃ KAN⁴², and so with all sulphates, oxalates, nitrates, and a host of other salts? And why, when the almost universal custom is to write sulphates as MSO₄, and nitrates as MNO₃, does our author write MO₄S and MO₃N?

We are glad to notice the introduction of the recent surmises as to the absolute weight of atoms, although at present we believe that such ideas cannot be of much

real use to the student. We are told that a milligram of hydrogen contains about 400,000,000,000,000,000 atoms of hydrogen, and a milligram of gold 2,000,000,000,000,000,000 atoms, while the atomic weight of gold is given as 196; if this is admitted, the milligram of gold will contain some 40816,000,000,000,000 atoms in excess of the number given above, and the omission of this will in itself show the extreme generality of such statements. A curious deduction as to the form of atoms is drawn from the fact that many minerals are observed, when reduced to powder, to preserve their normal crystalline form; hence, says our author, "we conclude the compound atom possesses form closely related to the cleavage form."

The law of Dulong and Petit is very concisely stated, and its importance in modern chemistry is well illustrated. It is crudely formulated thus:—if a represents the atomic weight and s the specific heat, the product as will be the specific heat S of a gram-atom of the substance, and $S = as$ nearly equal to 6.3.

Or again, if the specific heat S of an element be known, an approximate determination of the atomic weight can be found as follows:—

$$a = \text{nearly } \frac{6.3}{s}$$

Thus the specific heat of lead = 0.031, consequently $\frac{6.3}{0.031} = 200$, the exact atomic weight of lead being 207.

The service afforded by the application of this law to the determination of the *right* atomic weight of an element is also shown in this case of lead, for from the analysis of oxide of lead the atomic weight of lead might be 207, or 103.5, or 69, or 414, or 621, for although we find that sixteen parts by weight of oxygen are united with 207 of lead, we have no direct chemical proof that the 207 represents one atom; but the law of Dulong and Petit now steps in and shows us that the right atomic weight is 207, because it alone satisfies the conditions of that law. And so for other elements the vapour density of whose compounds cannot be determined. The section on Atomicity or valence would be much improved by the introduction of a complete list of the elements with their atomicities, and a discussion of doubtful atomicities.

In the seventh section the author passes at once from what were once called inorganic compounds to the discussion of organic substitutions as shown in the great methyl series of compounds. Such comprehensive statements as, "the binary marsh gas, also called methane, CH_4 , is the basis of all organic compounds," are of great use to the student, and in this instance the statement at once justifies the passage from mineral chemistry to so-called organic chemistry without one word of introduction or comment. We do not think that the attempted graphical representation of chemical constitution in the eighth section can be productive of anything but confusion to the student. The crosses and dots and three-limbed signs have themselves to be remembered, and cannot give any precise idea of the constitution of a complex compound. A somewhat detailed account of the constitution and syntheses of various serial compounds concludes that portion of the work devoted to Molecular Statics.

The second part commences with an account of the motions of molecules, and it is asserted that since molecules are not spherical, their impact against each other

will not alone produce motion of translation, but also motion of rotation, and this is partially illustrated by the motion of a boomerang. The following definitions are stated on the authority of the author:—

1. "The molecules of a body in the gaseous condition have a motion of translation, and also a motion of rotation around their natural axis of maximum moment of inertia."

2. "The molecules of a body when in the solid state have only a vibratory motion about a position of equilibrium."

3. "The molecules of a body when in the liquid state have a vibratory motion, as in the solid state, and also a motion of rotation around their natural axis of minimum moment of inertia."

Among the concluding sections of the book is a very interesting and suggestive account of *calorization*, that is the amount of heat produced or absorbed in any chemical process. The treatment (p. 153), from a calorization point of view, of the reactions of hydrogen, chlorine, iodine, and silver, is worthy of careful study. A few pages at the end of the book treat of Systematic Chemistry and Applied Chemistry.

Dr. Hinrich's book must be used in connection with his former works, "Elements of Chemistry" and "Elements of Physics," to which frequent references are made. It is mainly intended as a guide to the student, and must be used with the assistance of a teacher. To the advanced student it will be found to be of great use, and most eminently suggestive; but it will be almost useless to any reader who has not before acquired the main principles of chemical science, together with a large storehouse of chemical facts. The work is somewhat disfigured by numerous misprints—*dissociation* (p. 21), *amides* (p. 73), *reduction* (p. 109), *enery* (p. 113), &c., and we think the two plates at the end are extremely confusing; but these minor matters are easily remedied in a second edition, and need not detract greatly from the value of a really useful and comprehensive work.

G. F. RODWELL

THE ZOOLOGY OF THE "EREBUS" AND "TERROR."

The Zoology of the Voyage of H.M.S. "Erebus" and "Terror," under the command of Captain Sir James Clark Ross, R.N., F.R.S., during the years 1839 to 1843. By authority of the Lords Commissioners of the Admiralty. Edited by John Richardson, M.D., F.R.S., &c., and John Edward Gray, Esq., Ph.D., F.R.S., &c.

No. XIX.—*Insects* (conclusion). By Arthur Gardiner Butler, F.L.S., F.Z.S., &c. 1874.

No. XX.—*Crustacea*. By Edward J. Miers. 1874.

No. XXI.—*Mollusca*. By Edgar A. Smith, F.Z.S., &c.

No. XXII.—*Birds* (conclusion). By R. Bowdler Sharpe, F.L.S., F.Z.S., &c. 1875.

No. XXIII.—*Mammalia* (conclusion). By John Edward Gray, Ph.D., F.R.S., F.L.S., &c. 1875.

No. XXIV.—*Reptiles* (conclusion). By Albert Günther, M.A., M.D., Ph.D., F.R.S., V.P.Z.S. 1875.

THE non-completion of the "Zoology of the Voyage of the *Erebus* and *Terror*" has long been a public scandal. The celebrated voyage of these ships,

commonly known as the "Antarctic Expedition," took place in 1839, and the four following years. Dr. Hooker, under the title of "Assistant Surgeon" to the *Erebus*, was the Naturalist of the Expedition, and assisted by Messrs. McCormack and Robertson, the medical officers of the vessels, made an extensive collection of specimens in every department of zoology and botany. The botanical specimens were sent to Kew; the zoological to the British Museum. Dr. Hooker undertook the working out and publication of the former, and Dr. Gray of the latter. At the recommendation of the Admiralty the Government granted the sum of 2,000*l.* for the illustration of the work, half of which was assigned to the botanical and half to the zoological portion. Dr. Hooker's labours resulted in the two large quarto volumes which form the well-known "Botany of the Antarctic Expedition," and remain to the present day the standard authority upon the plants of the southern hemisphere. Very different were the results achieved by the thousand pounds bestowed upon the zoological portion of the work. After the publication of eighteen numbers, the various sections assigned to the different naturalists were left, one and all, incomplete, and have thus remained until the present day. Whether this untoward result was occasioned by the fault of the editor or of the publisher, or by misunderstandings between the two, has never been divulged to the public, nor does it now much concern us to inquire. Whichever may have been the case, the result was equally discreditable to the parties concerned. It is with pleasure, however, we see that the scandal exists no longer. An enterprising publisher has bought up the "remainder" of the plates of the unfinished work, and made arrangements for its completion. Whether it was justifiable on the part of the vendor to sell what had been produced by public money may be open to some doubt, but the purchaser, Mr. Janssen, is at all events entitled to the credit of having done all he could to bring this long neglected work to a satisfactory conclusion. The six numbers of the "Zoology of the *Erebus* and *Terror*" now before us, conclude the different sections, and enable the subscribers after twenty years of patient expectation to send their copies to the binders. On turning over the pages of the lately issued numbers, we find many admirably executed plates among them, and much valuable contribution to Zoological science. Dr. Günther's synopsis of the Australian Lizards is of special interest, and will, we are sure, prove most acceptable to the working naturalists of the Australian Colonies. As regards some of the illustrations of the birds, we may remark that the colouring is not very well executed—notice especially the figures of the King and Emperor Penguins. This is the more the pity, as the figures themselves are the productions of Mr. Wolf's artistic pencil.

OUR BOOK SHELF

Flora of Eastbourne. Being an Introduction to the Flowering Plants, Ferns, &c., of the Cuckmere District, East Sussex, with a Map, by F. C. S. Roper, F.L.S., &c., President of the Eastbourne Natural History Society. 8vo, pp. 165. (London, Van Voorst.)

THIS is an admirable little book of its kind, the greatest care and conscientiousness having evidently been exercised

in its compilation. The plan adopted by the author was to include only such species as he had actually gathered himself, or of which he had seen authentic specimens, hence a considerable number of species which we know, from personal observation, to grow within the limits of the Cuckmere district are omitted, or only given in an appendix. However, Mr. Roper will doubtless soon publish a supplement, and the basis upon which he has started is far preferable to the indiscriminate admission of everything from sources of uncertain value. Another cause for the absence of certain species is the quite recent extension of the field of operations to coincide with the Cuckmere drainage district of Mr. Hemsley's projected flora of the whole county. This forms an irregular triangle, having its apex on the ridge of the weald at Cross-in-hand, and its base running along the coast from the Signal House, east of Seaford, to St. Leonards. Its area is about 150 square miles, and it comprises a great variety of soils and situations, but there is very little boggy land, consequently a paucity of bog plants. Mr. Roper's list numbers 700 species, which further explorations will probably augment by about one hundred. It is surprising that such plants as *Papaver dubium*, *Arenaria trinervis*, *Rubus discolor*, *Campanula rotundifolia*, *Ophrys muscifera*, *Juncus maritimus*, *Aira flexuosa*, *Bromus giganteus*, &c., should have escaped observation; but such is the case, and they are not included in the *Flora*. Among the more interesting plants of this part of Sussex, and not found elsewhere in the county, we may mention *Phyteuma spicatum*, *Pyrola minor*, *Bupleurum aristatum*, *Seseli Libanotis*, *Sibthorpia europaea*, and *Bartsia viscosa*. The *Pyrola* was recently discovered in Sussex for the first time by Mr. Roper, so the botanist should never despair of finding something new. The *Flora of Eastbourne* has appeared just at the right time for visitors to Eastbourne this season, who will find it a valuable guide, and all the more welcome, perhaps, because there is a chance of adding to the number of species it includes. We should add that, like most local floras of recent publication, it simply treats of the distribution of the plants, but the book before us differs from most others in its copious references to other works, which will be useful to amateurs who may have occasion to consult descriptions or plates.

We may here mention that we have received a circular from the Lewes and East Sussex Natural History Society respecting a projected Fauna and Flora of East Sussex, which will be forwarded to any person interested in the work on application to the Secretary, Mr. J. H. A. Jenner, Lewes.

Repertorium der Naturwissenschaften. Monatliche Uebersicht der neuesten Arbeiten auf dem Gebiete der Naturwissenschaften. Herausgegeben von der Redaction des *Naturforscher*. (January to June 1875, Nos. 1 to 6, Berlin.)

THIS is a useful supplementary publication to *Der Naturforscher*. It consists of sixteen columns (the columns are numbered and not the pages) in quarto form. The number for May is made up of twenty-four columns, and gives the titles of more than 600 papers, which are published in upwards of eighty separate works. The periodicals thus indexed are the *Monatsberichte* (Berlin), *Comptes Rendus* (Paris), *Botanische Zeitung* (Leipzig), *Flora* (Regensburg), *Hedwigia* (Dresden), *Proceedings of the Royal Society* (London), *American Journal of Sciences and Arts* (New Haven), *Geographical Magazine* (London), *Messenger of Mathematics*, *Astronomische Nachrichten* (Kiel), &c. Though there are several publications we miss, both English and foreign, it will be seen that a good beginning is here made, and that there is a prospect in time of students being fairly informed of what is being done in science in this country and elsewhere in a compact publication issued at a reasonable rate.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

Properties of Selenium

In a letter headed "Anomalous behaviour of Selenium," which appeared in *NATURE* (vol. xii., p. 187), Mr. Gordon states that "it has lately been observed that the electrical resistance of selenium is greater in light than in the dark." I am anxious to learn where an account of this remarkable observation is to be found.

Mr. Gordon afterwards announces the discovery that a bar of granular selenium belonging to the Cavendish Laboratory exhibits a decrease of resistance under the influence of light. This phenomenon was well-known outside the Cavendish Laboratory more than two years ago. Mr. Gordon also states that the very high resistance of a certain medal of selenium did not sensibly alter under the influence of light; and concludes that "the physical form of the metal" seems to have some influence on its electrical properties. From his description of the medal it would appear that it is made of vitreous selenium. I am therefore surprised that its resistance was so low. A conducting form of selenium having the appearance of black-lead is certainly a novelty.

It is perhaps not generally known that the electrical properties of selenium are very variable. In a paper by Mr. Henry Draper and myself which appeared in the "Proceedings of the Royal Irish Academy" (vol. i. ser. ii. (Sci.) p. 529), we have shown that there is a granular variety of the element which is, at ordinary temperatures, apparently as good a non-conductor as the vitreous variety. Unlike the latter, however, it cannot be rendered electrical by friction. Another granular modification of the element was found to conduct electricity comparatively well in darkness, and scarcely any better under the influence of light; while there is an intermediate state of the element which appears to possess a molecular structure so susceptible of change, that light is capable of converting it temporarily into the form which conducts comparatively well. Some bars which we prepared of this sensitive variety exhibited an increased conductivity of 100 per cent. under the influence of sun-light. In appearance there is not the slightest difference between this and the non-conducting granular variety, both exhibiting a gray granular fracture resembling that of the metal cobalt. In the course of our experiments Mr. Draper and I prepared a large number of bars and plates of various shapes and sizes, but we have not observed any unusual connection between the shape of the bars or plates and their resistance. There is a great difficulty in making observations with reference to this point, as we are as yet unable to produce two or more bars of the sensitive variety possessing the same electrical properties. Thin plates are generally more sensitive to light than cylindrical bars, but we have occasionally prepared bars as sensitive in proportion as a plate measuring 75×15 mm., and only 0.5 mm. in thickness.

I have not as yet been able to learn the contents of Prof. Adams's recent paper on this subject, but Mr. Gordon says that he has shown that the phenomenon is a purely optical one. I may state that Mr. Draper and I have long since shown that, so far as the effect of heat on electrical resistance is concerned, some forms of granular selenium conform to the metallic type. This was demonstrated by placing a plate of selenium inside a spiral of platinum, at a distance of about 4 mm. from the wire. The usual decrease of resistance took place when the plate was exposed to light; but on heating the surrounding platinum wire by passing a current of electricity through it, the resistance of the selenium increased considerably. The effect of light is therefore partially counterbalanced by the effect of the heat which usually accompanies it. This partly explains the increase of resistance that is known to follow prolonged exposure to light. A portion of this increase being doubtless due to the slight elevation of temperature that must result from the passage of the current through the selenium. The opposite action of light and heat is very remarkable, especially as the longest light undulations are those that cause the greatest decrease of resistance. It is remarkable, also, that a thin film of non-conducting vitreous selenium transmits these red rays, while an equally thin film of granular selenium is perfectly opaque to them.

RICHARD J. MOSS

Mr. Darwin and Prof. Dana on the Influence of Volcanic Action in preventing the growth of Corals

In his critique on the new edition of Mr. Darwin's work on Coral Reefs (*NATURE*, vol. x., pp. 408-410), Prof. Dana adduces four examples of islands in which he thinks comparatively recent volcanic action has prevented the formation of extensive coral reefs. One of these is Savaii, the largest island of Samoa.

Some time ago I read Prof. Dana's "Corals and Coral Islands," while on a tour on Savaii, and on the margin of page 302 I noted this very point now brought forward by the author in his paper in *NATURE*, intending, at some future time, to show that his view respecting this island is based upon imperfect knowledge, and is altogether incorrect.

I do not intend to enter here into all the details respecting Prof. Dana's incorrect statements, but will confine myself to the one point on which his views and those of Mr. Darwin are at variance. In his work (p. 302) Prof. Dana says: "Savaii abounds in extinct craters and lava streams, and much resembles Hawaii in character; it bears proof in every part of being the last seat of the volcanic fires of the Samoan Group. *Its reefs are consequently few and small.*" In *NATURE* (vol. x. p. 409), he says: "Savaii has coral reefs on its western (eastern) and northern shores, while elsewhere without them. *I failed to find evidence in the case of either of these volcanic regions that they are situated within areas of elevation rather than subsidence. Only ten miles west (this should be east) of Savaii lies the large island of Upolu, having very extensive reefs—on some parts of the north side three-fourths of a mile wide; and it has not seemed safe to conclude that while Upolu thus bears evidence of no movement or of but little subsidence, Savaii was one of elevation; or that the north and west (east) sides of Savaii have differed in change of level from the rest of the island.*"

In the above passage Prof. Dana has reversed the relative positions of Savaii and Upolu. Savaii is west of Upolu, and its reefs are on the eastern end next to Upolu, and extend for some distance on its north-eastern side. Its south, west, and north-west sides are free from coral reefs except in bays, where they are very narrow.

Now what Prof. Dana did not consider it "safe to conclude," viz., that part of Savaii had "differed in change of level from the rest of the island," is nevertheless a fact. And more than that, those parts of the island which present unmistakable evidence of upheaval are destitute of a coral reef on their shores, except the narrow fringes above mentioned.

The elevated portions of the island commence at the south-eastern point, in a line with three small islands which stand in the straits between Upolu and Savaii, and which doubtless indicate the line of fissure. I have traced the upheaval for many miles along the southern coast. In some places there are old water-worn cliffs from twenty to thirty feet above the cliffs which at present form the coast line, and which are themselves from twenty to thirty feet above high-water mark. These old cliffs are usually within two or three hundred yards of the present coast line, but are sometimes more distant. I have not at present traced this upheaval around the entire western end of Savaii, but I have observed the point at which it commences on the northern side, as well as at the south-eastern extremity.

How this fact tells on the point on which Prof. Dana's view differs from Mr. Darwin's, I may leave to those who are familiar with the subject to decide. My own conviction is, that instead of furnishing proof of the correctness of Prof. Dana's view, Savaii supplies a remarkable example of the correctness of that of Mr. Darwin, that, *ceteris paribus*, the extent of coral reefs is chiefly determined by the depth of water on the coast.

I have visited and examined a good many intertropical islands of the Pacific belonging to the three orders: 1. Volcanic islands with fringing coral reefs, such as Samoa, the New Hebrides, &c. 2. Atolls, such as the Low Archipelago, Ellice, Gilbert Islands, &c. 3. Upraised coral islands, such as Niue or Savage Island, part of the Friendly, the Loyalty Islands, &c. I have studied their structure with Mr. Darwin's "Coral Reefs" as my text-book; and the further I have gone the more firmly have I been convinced of the correctness of his theory.

Prof. Dana is, without doubt, correct in his opinion that submarine or littoral volcanic action would destroy living corals which came within its influence; and it might for a time, even after the volcano became quiescent, prevent the spread of corals within the area affected by it. But the fact that in some of the areas where extensive reefs are not found, narrow coral fringes exist in bays (as at Savaii), where the slope of the shore is less

steep, is positive proof that the non-existence of extensive reefs cannot in such places be owing to any deleterious influences arising from volcanic action, but must be on account of the depth of water on the coast.

S. J. WHITMEE

Upolu, Samoa

Mirage on Snowdon

ON Monday, July 12, I, with a party, ascended Snowdon. The atmosphere was clear until we had reached within half a mile of the summit, when a light cloud rising stealthily from amongst the southern peaks enveloped it. Drifting towards us, when very near, the cloud dropped over the eastern shoulder of the mountain just where it dips towards Capel Curig. As we stood watching, great was our surprise and delight as we beheld painted upon it, not the *arc-en-ciel* with which we are familiar, but a complete and brilliant prismatic circle, apparently about thirty feet in diameter, in the very centre of which we ourselves were depicted, the image being somewhat enlarged but clearly defined; as we arranged the party in groups, or bowed to each other, every form and movement was faithfully reproduced in the picture. It was now about 8 o'clock, with the sun nearly in a line with us. Our guide, who had made some hundreds of ascents, had never witnessed such a sight before.

H. J. WETENHALL

Fordfield, Cambridge

OUR ASTRONOMICAL COLUMN

KEPLER'S NOVA, 1604.—We learn from Prof. Winnecke that, in consequence of the remarks upon this star which appeared in NATURE, vol. xi. p. 249, he has lately examined the neighbourhood, and, in addition to the star of 11th magnitude there mentioned—the position of which for 1855^o he finds to be R.A. 17h. 22m. 4^{6s}., N.P.D. 111° 23' 6"—he found one of 12th magnitude in R.A. 17h. 21m. 49^{3s}., N.P.D. 111° 19' 3". This star agrees almost precisely in place with the 10th magnitude marked upon No. 52 of Chacornac's charts, though not at present of that brightness; but we are able to state that in August 1871 and June 1872 nothing was visible in this position in a telescope which would show stars to 13th magnitude in Winnecke's scale. It will be desirable to watch this small star closely, as it is quite possible it might be identical with Kepler's famous star, the observed place of which is not so accurately known as in the case of the similar object observed by Tycho Brahe in 1572. Prof. Winnecke, however, suggests that, as the star marked by Chacornac is just upon the margin of his map, where some distortion exists, it might possibly be identical with No. 16,872 of Oeltzen's Argelander, a star estimated 8⁹ in the Bonn Zones; still the place of the 12th magnitude agrees much more closely with that of Chacornac's 10th, read off from his chart as nearly as the circumstances permit. It may be well to compare the fainter star found by Prof. Winnecke, from time to time with the 11th 12th close at hand, and easily identified if the instrument be set for Argelander's star, which may be considered a bright 9th magnitude.

THE BINARY STAR 4 AQUARI.—If good measures of this star are practicable during the present season, an idea of the form of the orbit may perhaps be obtained. Dawes's series of epochs will be of material service in this respect; without them, doubt might have been occasioned by the two discordant epochs of Mädler, which may have been owing to distorted images at low altitude. The object is certainly one of considerable difficulty, and really trustworthy measures are perhaps only to be expected from practised observers in command of instruments of excellent definition. In Barclay's second catalogue it is described as just elongated in the direction 144°, with power 450 on the 10-inch refractor at Leyton, at the epoch 1865⁷⁴; this angle shows direct progress, very much in accordance with Dawes's measures. Possibly the companion may now be found nearly due south of the primary.

THE NEBULÆ.—Prof. Schönfeld has published in Part II. of "Astronomische Beobachtungen zu Mannheim"—Carlsruhe, 1875—a continuation of the valuable series of observations commenced by him in 1860, for accurate determination of the positions of a selected list of nebulae. In this second part we have the places of 336 of these objects, obtained by direct reference to stars, which, as in the case of those employed in fixing the positions of the nebulae included in the first part (Mannheim, 1862), have been meridionally determined at Bonn by the late Prof. Argelander; the mean places are found in Vol. vi. of the Bonn Observations. Schönfeld's epoch is as before, 1865⁰, for which year the precessions are computed with Bessel's constants, still preferred by many of the German astronomers. The differences from Schultz's Preliminary Catalogue are shown, and are generally small. As one result of more recent observations, it is remarked by Schönfeld that a sensible proper motion of the great nebula in Andromeda, which appeared to be indicated by a comparison of Flamsteed's observations with those of D'Agelet and Lalande, is not confirmed.

Prof. Adams, in his last address as President of the Royal Astronomical Society, remarks upon the great value attaching to Schönfeld's micrometrical observations of the nebulae, of which we have here the continuation.

ENCKE'S COMET.—Mr. J. Tebbutt of Windsor, New South Wales, reports his discovery of a comet, which he supposed to be Encke's, on the morning of May 7th, in the constellation Cetus. It is, we believe, the second occasion upon which this able amateur astronomer has detected this comet, before the arrival of an ephemeris from Europe, and no doubt in the present case his independent discovery, which he communicated telegraphically to the Government astronomers at Sydney and Melbourne, will lead to a number of observations for position at the Australian observatories, which might have been otherwise lost. The search for comets without the aid of an ephemeris is hardly an occupation which can be expected in a public observatory, where time is valuable for routine work—hence an argument for the early and general publication of ephemerides—and an inducement for some amateurs, especially in southern latitudes where a great necessity for systematic sweeping of the sky in search of comets appears still to exist, to so employ their leisure time. One at least of the lost comets of short period, is far more likely to be recovered in the southern hemisphere, than in these latitudes.

THE ARGENTINE OBSERVATORY.—Dr. Gould has just circulated in two small pamphlets, in English, the annual Report for 1874 of proceedings at the Observatory of Cordoba, and at the Meteorological Office, which has also been organised by this distinguished astronomer. With regard to astronomical work, the observations for the "Uranometry" are completed, as already mentioned in this column. The charts will be thirteen in number, including the whole of the southern heavens as well as the first ten degrees north of the equator, and about 8,500 stars will be represented upon them, of which about nine-tenths have southern declination. A catalogue will accompany the Atlas, as with the works of Argelander, Heis, and Behrmann. The zone-work was in a very forward state, 82,537 stars having been observed, and with the exception of an insignificant number of zones for which it might be necessary to wait till a later period of the year, Dr. Gould expected to complete this laborious undertaking by the end of last month. The third of the principal sub-divisions of work at Cordoba, the formation of what is called "the smaller Catalogue" is also well advanced: the catalogue is intended to consist of nearly 5,000 of the brighter stars of the southern heavens, each one observed not less than four times; in the year 1874, 12,500 observations of 3,600 different stars were made, the greater number during Dr. Gould's visit to his native city, a sufficient proof that he has been

zealously supported in the extensive plans of observation arranged by him, by the other officers of the establishment. The great comet of 1874 was followed with the large refractor of the Argentine Observatory (which, Dr. Gould informs us, is an 11-inch by Fitz, of New York) until the 18th of October, the comet having been first seen there, in the morning twilight on July 27; at the last observation it was within about 12° of the South Pole. [Our last remarks on this comet should have been headed Comet, 1874 (III.).]

THE LATE W. J. HENWOOD, F.R.S.

THIS distinguished mining geologist, who died at Penzance last week, in his seventy-first year, was originally a clerk in the employment of Messrs. Fox, of Falmouth, to whose counsel he was considerably indebted in his early scientific work. By very great industry and careful observation he acquired an unsurpassed knowledge of the mineral deposits of Cornwall and Devon, and after fulfilling a succession of important mining appointments, he became Assay Master of tin to the Duchy of Cornwall. This post being abolished, Mr. Henwood's great experience was utilised in reporting upon and developing a number of mining districts in South America, Canada, &c.; and after the cessation of his travels, he lived at Penzance in comparative retirement. His great works are the fifth and eighth volumes of the "Transactions of the Royal Geological Society of Cornwall," devoted respectively to the metalliferous deposits of Cornwall and Devon, and to those of the foreign countries he had visited. But his scientific writings, besides these, were very numerous; a list of them occupies seven columns in the "Bibliotheca Cornubiensis."

As a scientific man Mr. Henwood was characterised by indefatigable labour, great caution, love of accuracy, and moderation of expression. In his publications he scarcely ever mentions a fact of any kind which had not come under his own experience, without giving the authority for it. Thus many of his writings are marvels of copious reference. He persisted in doing everything with this extraordinary amount of labour and care up to the last, notwithstanding that he suffered for many years from a very painful heart-disease. His scientific work ceased only with his death. So long as he could sustain even an hour's intellectual effort during the day, that was devoted to the arrangement of his stores of facts and observations. I believe that scarcely one of his cherished objects in this respect remains unfulfilled.

Mr. Henwood's address to the Royal Institution of Cornwall in 1871, extending, with references, to sixty-five pages, affords ample evidence of the value of his observations and of his scientific ability. It includes the most admirable and complete compendious account of the mode of occurrence of metalliferous deposits in Cornwall which has yet appeared, and is characterised by that absence of theoretical assumption which specially marked him as an observer. The orderly arrangement of accurately-observed facts was his object; theorising he had little affection for; suspended judgment on unproved theories was his consistent attitude.

In personal character Mr. Henwood won the high regard of all who knew him intimately. His acquaintance with men and manners was so great and varied, his memory so retentive, and his conversational style so simple and lucid, that to talk with him was one of the most delightful and instructive of intellectual recreations. His estimate of his own labours and merits was unaffectedly modest, although he would resist, if possible, any unfair representation of his work.

In the spring of the present year the Murchison Medal of the Geological Society was awarded to Mr. Henwood. An extract from a letter written by him to a friend on this subject may fitly close this notice: "Mr.

Evans's far too flattering estimate of my poor labours was most kindly intended. Although the distinction cannot but afford me pleasure, this is as nothing compared with the kind, and even affectionate, congratulations of yourself and my other friends. All these I carefully preserve, as they will show what I have done far better (though in an undeservedly favourable light) than the mere official record."

G. T. BETTANY

THE INTERNATIONAL CONGRESS AND EXHIBITION OF GEOGRAPHY

THE Geographical Exhibition continues to have increasing success, although the price of admission has been raised, except for schools, for which the original price, a penny a head, has been kept, and the galleries are crowded with children under the guidance of their teachers. It is said that all the soldiers of the garrison of Paris will be marched through the galleries under the guidance of their officers, when the Congress is over. The Exhibition will be prolonged to the end of the month.

Several improvements have been made in the English section since our last notice. Examples of the several maps published by the Ordnance Survey have been exhibited from an inch to ten feet per mile. Although completed only at a late period, the exhibition of the Geological Survey of Great Britain has been very successful; an immense number of maps have been exhibited, and are said to be the finest in the whole exhibition building. We might refer to a number of other exhibits honourable to English enterprise, but we must confess that Russia has carried the day, not on account of her private enterprise, but in consequence of the strenuous action of the Government. It is very likely that St. Petersburg will be chosen by common consent for the seat of the next geographical exhibition.

M. Glöesener, member of the Royal Academy of Sciences of Belgium, exhibits a chronograph available for registering the flight of projectiles as well as for recording astronomical observations for the determination of longitude. The cylinder can be put into rotation at the rate of four turns in a second or one turn in thirty seconds, according to the order of phenomena. It requires only the power of Daniell cells and ordinary magnet needles, without any electrical spark. It is very cheap, compact, and easy to set in operation.

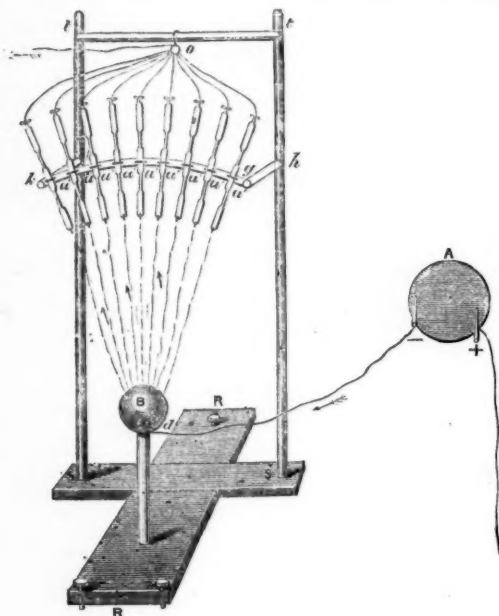
The Rysselberghe self-registering meteorograph has been admitted, as we have already noticed, to supersede any similar instrument in existence. Copper plates engraved automatically can be used in printing, having turned into relief by the processes already described.

M. Lynström, of the University of Helsingfors, has sent to the Geographical Exhibition an interesting instrument invented by him to demonstrate that auroræ are produced by electrical currents passing through the atmosphere in the polar regions. The apparatus is put daily into operation by M. Mohn, the director of the Meteorological service of Sweden, and it was constructed at the expense of Mr. Oscar Dickson, the Gottenburg merchant, who has fitted out the Swedish Polar Expedition under Prof. Nordenskiöld. Our illustration will give an idea of the apparatus.

A is an electrical machine, the negative pole being connected with a copper sphere and the positive with the earth.

S S' are of ebonite as well as R R', so that B is quite isolated as the earth in the space. B is surrounded by the atmosphere. $a' a' d' d' a'$ are a series of Geissler tubes with copper ends above and below. All the upper ends are connected with a wire which goes to the earth, consequently a current runs in the direction of the arrows through the air, and the Geissler tubes become luminous when the electrical machine is set into operation.

These Geissler tubes represent the upper part of the atmosphere which becomes luminous when the aurora borealis is observed in the northern hemisphere. The phenomena produced by the Lynström apparatus are quite consistent with the theory advocated by Swedish observers that electrical currents emanating from the earth and penetrating into the upper regions produce auroræ in both hemispheres. The experiment differs from the



apparatus of M. De la Rive, who placed his current *in vacuo*, and did not show the property of ordinary atmospheric air of allowing to pass unobserved at the pressure of 760 mm. a stream of electricity which illuminates a rarified atmosphere. The experiment is most attractive, and hundreds of persons witness it every day.

The arrangements for the general daily meetings of the Congress are very good. Every morning the seven sections meet at nine o'clock and discuss the subjects placed on the *ordre du jour*. At three o'clock all the members meet in the Salle des Etats, under the presidency of one or other of the presidents of the various geographical societies of Europe. No discussion takes place at these general meetings, but the presidents of sections report on the discussions which have taken place at the morning sitting. Consequently, all who attend the evening meeting obtain a summary of the transactions of the day. Visitors are admitted to the general meetings only. Sometimes several sections meet together in the morning to deliberate on subjects of common interest, and general deliberations will be proposed at the end of the session.

A subject very much discussed has been the adoption of a first meridian. Struve proposed Greenwich. One of the most interesting questions has been on the substitution of the centesimal for the sexagesimal division of the quadrant, or of the entire sphere. It was decided by twenty-three to seven in favour of the centesimal division of the quadrant, reserving the larger question of its extension to the entire sphere till the matter is brought before the general meeting. The present system found no advocate. M. Bousquet de la Griè's proposal for dividing the compass into 360 points, to be reckoned from left to right, has also been approved.

The question of ascending currents in the atmosphere has been seriously discussed, M. Faye maintaining that only descending waterspouts have been observed. M. Faye's theories, however, have found very little support. The general opinion, as supported by Mohn and others, being that no descending current can be observed without an ascending one, so that there is a circular rotation of the atmosphere in altitude, and the upper strata are in constant communication with inferior strata of the atmosphere.

A commission has been appointed on the question of a great Transiberian railway. The Russian colonel Bogdanovitch spoke in favour of a line by Ekaterineburg and Tiumen, which has the advantage of putting Europe into communication with the large rivers of Southern Siberia. He said that the Russian government had decided upon the construction of a section 1,000 miles long.

Lectures were delivered by MM. Gerard Rohlfs, Nachtigall, and Schweinfurth, on the exploration of Central Africa, and these intrepid explorers answered a number of questions in reference to their travels.

On Sunday about 300 members, amongst them a number of ladies, visited Compiègne to see the museum of Cambodian antiquities, collected by M. Delaporte, a lieutenant in the French national service, and exhibited in the ex-imperial palace inhabited by Napoleon III. M. Delaporte published in 1873, at Hachette's, a large work in two folio volumes, with an immense number of illustrations, and a graphic atlas in chromolithography. The King of Cambodia, having been admitted to a French protectorate, sent a number of antiquities to Compiègne, where M. Delaporte has organised the museum which was visited on Sunday. M. Delaporte himself was in attendance to explain the manner in which all those astonishing relics of an unknown part had been brought to light. These monuments have undergone a systematic destruction, it is supposed, in the fifth century B.C., and are mostly concealed in the centre of immense forests which have grown since that time, and situated in infested districts which are mostly inhabited by tigers and poisonous snakes. It was M. Jules Simon who had the honour to grant the mission whose results have been so fruitful, and the zeal elicited by explorers was so great that the credit of 10,000 francs granted was almost sufficient to collect a quantity of stones which fill the basement of the Palace.

Of the juries appointed by the Geographical Congress five have given their awards, while the remaining two have not yet come to any decision. Letters of distinction, the highest reward the Congress can bestow, have been conferred upon England—namely, in Group 1 upon the Topographical and Trigonometrical Office of India and the Ordnance Survey Office of Southampton; in Group 2 upon the Hydrographic Office; in Group 3 upon the Meteorological Office, the office of Geological Survey of Great Britain, and the Royal Geographical Society of London; in Group 4 upon the Palestine Exploration Fund for maps and plans and photographic reliefs. Letters of distinction have also been conferred in the United States upon: Group 2 the Navy Department; Group 3 the United States Signal Service, and upon Mr. William Martin for a description of the island of Hawaii. Numerous first-class medals have, moreover, been conferred upon Englishmen and Americans.

THE MANATEE AT THE ZOOLOGICAL GARDENS

OF those mammalian animals which, instead of making their customary abode the land, reside in water either fresh or salt, the Seals and Porpoises are best known by sight to the public at large. These two just named animals are representatives of two great zoological groups, the Pinnipedia and the Cetacea, the relationships

between which are not at all intimate; in other words, notwithstanding the similarity in their habits, they must have been derived independently from different, probably terrestrial, mammalian ancestors, which themselves were not intimately related. The Pinnipedia include the Seals, Sea-Lions, and Walruses, animals closely allied to the Bears, Dogs, and Cats. The Cetacea include the Whales, Dolphins, and Porpoises, which are so much modified that their correct affinities are still matters of doubt.

There is, however, still another aquatic mammalian group or order which at the present time includes among its members only two well-marked forms or genera; these being the Dugong and the Manatee. The order is that of the Sirenia, and its members differ in their organisation considerably from both the Seals and the Whales, more nearly approaching the latter, and appearing to be most nearly allied to the Ungulate Herbivora.

The Manatees—of which there are two well-defined species, one found in and at the mouths of the rivers discharging themselves on the eastern coast of intertropical America, and the other on the opposite side of the Atlantic Ocean, on the shores of Western and Southern Africa—are large-sized somewhat seal-like herbivorous animals, sometimes reaching 17 feet in length, differing from the Seals and resembling the Whales in not having any indications of hinder extremities, at the same time that the caudal portion of the body is expanded into a horizontally-flattened tail. In them the contour of the face is peculiar, the whiskered snout being much flattened, like a pointed cone with a considerable portion of the end cut off transversely. The large nostrils are situated within a short distance of one another, at the upper portion of the truncate edge; they are closed by valves during the time that the animal is submerged. The eyes are peculiarly small and inconspicuous. The external ears are wanting. The mouth is small, without front teeth, and is placed low down, the gape being close to the anterior end of the animal. The neck, from its extreme shortness, can scarcely be said to exist as such.

Neglecting the tail, the body, which is very sparsely covered with hair, has the shape of a much elongate barrel, slightly flattened above and below. The skin is very like that of the Hippopotamus. Far forward, just behind the head, the two fore-limbs project laterally from below. The elbow is conspicuous, though placed not far from the side, and the fore-arm together with the hand, form a flat oval flapper devoid of any indications of fingers, except that at the extreme edge rudimentary nails are developed. These arms are used by the animal as claspers, which can be flexed over the chest; employed as locomotor organs at the bottom of the water, or made to assist in the prehension of food. In the female the mammae are pectoral, and the consequent general configuration has probably led to the fabulous descriptions of the existence of "mermaids."

In shape the tail is unlike that of any other animal, being spatulate. It most resembles that of the Beaver, but is a direct continuation backwards of the body, and is covered with an unmodified skin. As in the Whales and Beavers, the vertebral column forms a bony axis of support for the flattened muscular and fibrous expansion covered with thick cuticle, which forms the propelling mechanism.

The skeleton is of an extremely dense texture and very massive; the skull and ribs more resembling ivory than bone. In the number of the vertebrae which form the neck there is also a peculiarity, not shared even by its ally, the Dugong. In all mammalia there are seven cervical vertebrae, the same in the Giraffe as in the Elephant, in the Kangaroo as in Man. In the Manatee there are, however, only six, as in one other mammal only, namely, Hoffmann's Sloth. The ribs, as well as being very dense, are broader than is usually the case. As in the

Whales there are no bony traces of hind limbs, a rudimentary pelvis being alone found.

As far as the soft parts are concerned, it may be mentioned that the apex of the heart is deeply cleft, more so than in the Elephant and the Seals. This is the case also in the Dugong. The arteries in many parts break up into innumerable minute branches before they become distributed, to form the so-called *retia mirabilia*. The lungs run a considerable distance along the back of the animal, nearly reaching the root of the tail, instead of being entirely included in the thoracic region.

The half-grown female Manatee which has just reached the Zoological Society's Gardens, is the first living specimen which has been seen in this country. It came from the coast of Demerara, and was three weeks on the journey, during which time it was in a big swinging tank constructed to hold it. Two previous unsuccessful attempts were made in 1866 to forward living specimens to Regent's Park; in one case the animal did not die till within two days of its reaching Southampton. The valuable memoir by Dr. Murie in the eighth volume of the Society's *Transactions* was based on the dissection of these two specimens, which were preserved immediately they died in a condition fit for minute investigation.

The living animal appears to be in a good state of health, its movements are much less active than those of the Seals, and as food it takes vegetable marrow and lettuce in preference to anything else.

A third member of the order Sirenia was the *Rhytina*, a toothless animal, sometimes reaching 24 feet in length, discovered by Steller during Behring's expedition in 1741 on the shores of the island which bears his name. The slaughter of these creatures for their flesh was so recklessly conducted that they had all disappeared in 1789, and have never been seen since. There are three skeletons of this extinct species (*Rhytina stelleri*) in existence, all in Russia.

THE WÖHLER FESTIVAL

THE 31st of July was a festive day for Chemical Germany, and for the numerous admirers of the celebrated senior of German chemistry, Prof. Wöhler of Göttingen; not only as the seventy-fifth anniversary of his birth, but also as the supposed fiftieth anniversary of his entering upon his professional duties. In 1825 Dr. Wöhler became teacher of chemistry to the Berlin "Gewerbeschule;" in 1831 he exchanged this position for a similar one in Cassel, and from 1836 up to the present day he has been forming generations of chemists who flocked to Göttingen attracted by his fame. We need not remind our readers of the numerous discoveries of this great and genial man, of which the artificial formation of urea, the production of aluminium, his researches on cyanic and cyanuric acids, on boron and silicon, his joint researches with Liebig on uric acid and benzoyl-compounds, and many others, are known to all chemists, and have opened new roads to science.

From eight o'clock in the morning until noon of the above-mentioned day, one deputation relieved another to express their thanks and congratulations. The Faculty of Science of Tübingen sent a diploma of Doctor of Science, so that similar to the triple crown of the Head of the Roman Church, three doctor's degrees, that of Medicine, of Philosophy, and of Science are now worn by the Head of German Chemistry. The German Chemical Society at Berlin was represented by three members of its council, two of this deputation being pupils of Dr. Wöhler. They presented an appropriate address in a handsome cover of malachite, an allusion to the services rendered by the great chemist to the allied science of mineralogy. In the evening many of the undergraduates of the University (now eleven hundred in number) expressed their admiration in the time-honoured shape of a torch procession.

The following day found Prof. Wöhler unbent by the honorary burden of the 31st of July, and some privileged friends and pupils had the pleasure of seeing him working at the analysis of a new mineral with the same zeal he would have shown fifty years ago. This formed the most pleasant part of the Wöhler Festival, being a hopeful sign of the vigour and power left to this great man. The readers of NATURE (vol. xii. p. 179) were able, only a few weeks ago, by the perusal of extracts from charming recollections of Prof. Wöhler's youth, to witness a similar proof. In fact, his youth has accompanied him into his old age.

A. OPPENHEIM

THE GIGANTIC LAND TORTOISES OF THE MASCARENE AND GALAPAGOS ISLANDS*

III.

I WILL now indicate the characteristics of the different races which I have been able to recognise in the materials to which I have had access.

It has been mentioned above that the principal mark of distinction is in the form of the skull: some species having a depressed skull with the surface flat above, whilst in others it is much higher and convex above. Hand-in-hand with this difference in the skull goes another in the pelvis; the flat-headed Tortoises having a broad, horizontally dilated bridge between the obturator foramina, whilst in the round-headed form the bridge is vertically compressed. Such a distinction might have been expected between the Galapagos Tortoises on the one hand, and the Mascarene races on the other; but what justly excites our surprise is that the Galapagos Tortoises and the extinct forms of the Mascarenes belong to the same (the flat-headed) type and that, therefore, a much greater affinity exists between them, than between the extinct and living races of the Mascarenes.

I.—FLAT-HEADED TYPE

A. The *Galapagos Tortoises* may be recognised by the invariable absence of a nuchal plate, by the convergence of the posterior margins of the two gular plates which never form a straight line, by the black colour of the shell, by a large scute of the inner side of the elbow, by the double alveolar ridge of their jaws. Among the carapaces which I have examined I can distinguish five forms; of the first four severally two are more nearly related to each other than to the other pair, the fifth being intermediate between these two pairs. The degree of distinctness and affinity which obtains in the carapaces is expressed clearly and in exactly the same manner in the skulls, as will be seen from the following characteristics:—

1. In the first species (*Testudo elephantopus* of Harlan) the shell is broad and depressed, with the upper anterior profile sub-horizontal in the male, and with corrugated but not deeply sculptured plates. Sternum truncated behind. The snout is very short. Skull with an immensely developed and raised occipital crest, with a sharp outer pterygoid edge, and a deep recess in front of the occipital condyle. The skeleton of a fully adult male example and one of an immature female are in the Oxford Museum and the collection of the Royal College of Surgeons. Young individuals are by no means scarce in collections. Either this species or the next appears to have inhabited James' Island.

2. *Testudo nigrila* has likewise a broad shell which, however, is considerably higher than in the former species; the anterior profile in the male is declivous, and the plates are deeply sculptured. Sternum with a tri-

* The substance of this article is contained in a paper read by the author before the Royal Society in June, 1847, and will appear in the forthcoming volume of the "Philosophical Transactions," and to which I must refer for the scientific portion and other details. Some facts which have come to my knowledge subsequently to the reading of this paper, are added. Continued from p. 261.

angular excision behind. The snout is longer and the occipital crest low; but the outer pterygoid edge is equally sharp, and the recess in front of the occipital condyle equally deep as in *T. elephantopus*. The principal specimens examined by myself of this species, are one 41 inches long, in the British Museum; the type of the species (described and named by Dumeril and Borbron) in the collection of the Royal College of Surgeons; and the large skull in the British Museum, figured by Dr. Gray under the name of *Testudo planiceps*.

3. Porter's account of the race inhabiting Charles Island is sufficiently characteristic to enable us to recognise it in an adult specimen, the shell of which is elongate, compressed into the form of a Spanish saddle, and of a dull colour without any polish. The sternum is truncated behind. Skull with the outer pterygoid edge flattened, with the tympanic cavity much produced backwards, and without recess in front of the occipital condyle. The only adult example which I have examined is 33 inches long, and belongs to the Museum of Science and Arts, Edinburgh. It was lent to me by the Director, Mr. T. C. Archer, who most kindly allowed the skull and limb-bones to be extracted, which could be effected without the least injury to the outward appearance of the specimen. This species I have named *Testudo ephippium*.

4. The smallest of the Galapagos Tortoises is one for which I have proposed the name *Testudo microphytes*, the carapace of a fully adult male being only 22½ inches long. We may presume that this specimen, for an examination of which I am indebted to the Museum Committee of the Royal Institution of Liverpool, is a representative of the race from Hood's Island, Porter having expressly stated that the tortoises of that island are small, and similar to those of Charles Island. Indeed, the shell is elongate as in *T. ephippium*, but the anterior profile is declivous. The skull has the characteristics of a young skull of one of its more gigantic congeners; the outer pterygoid edge is flat, and there is no recess in front of the occipital condyle, as in the species from Charles Island.

5. In the last species (*Testudo vi.ina*) the skull is depressed as in the first, with the upper exterior profile sub-horizontal in the male, and with the lateral anterior margins reverted so as to approach the peculiar shape of *T. ephippium*. The concentric sculpture of the plates is distinct. Sternum of quite a peculiar shape, much constricted and produced in front, and expanded and excised behind. The skull is extremely similar to that of *T. ephippium*. Unfortunately nothing is known of the history of the adult male example which formerly was in the possession of Prof. Huxley and ceded by him to the collection of the British Museum.

B. The *Mauritian Tortoises*.—It would be a matter of considerable interest to ascertain whether the tortoises of Mauritius lacked the nuchal plate, like the Galapagos races to which in other respects they are so closely related. The only carapace which I have seen is deprived of the epidermoid scutes, and, besides, so much injured in the nuchal region that it is impossible to determine the absence or presence of a nuchal plate. But the Mauritian tortoises were characterised by a peculiarity hitherto unknown among recent land tortoises, viz., by a treble serrated dental ridge along the lower jaw.

The examination of a considerable number of bones, part of which were obtained during the search for Dodo-bones, and are now in the British Museum, whilst for others from the district of Flacq I am indebted to M. Bouton, has convinced me of a multiplicity of species in this island. The majority of the bones were found near Mahebourg, in a ravine of no great depth or steepness, which apparently once conveyed to the sea the drainings of a considerable extent of circumjacent land, but which has been stopped to seaward most likely for ages by an accumulation of land. The outlet from this ravine having

been thus stopped, a bog was formed called "La Mare aux Songes," with an alluvial deposit varying in depth from three to twelve feet. The tortoise bones occur at a depth of three or four feet, imbedded in a black vegetable mould; lighter coloured specimens are from the vicinity of the springs. (Zool. Trans., vi. p. 51). Among these bones I have distinguished four species, the more important characteristics of which may be particularised as follows:—

1. *Testudo triserrata*.—Proximal half of the scapula trihedral, with the anterior side convex; acromium trihedral, straight. Coracoid ankylosed to scapula at an early stage of growth. Humerus moderately slender, with the shaft flattened, and a deep hollow between the head and tuberosities. Shaft of the ulna narrow, much twisted. Ossa ilei short and broad; transverse and vertical diameters of pelvis subequal; front part of pubic bones abruptly bent downwards. Femur stout, with much dilated condyles; a deep and broad cavity between the head and trochanters.

2. *Testudo inepta*.—Proximal half of the scapula trihedral, with the anterior side concave; acromium compressed, with the end curved. Coracoid never ankylosed to the scapula. Humerus moderately slender, with the upper half of the shaft trihedral, and without hollow behind the head. Shaft of the ulna broad, not much twisted. Ossa ilei narrow and long; vertical diameter of pelvis much exceeding in length the horizontal; front part of pubic bones gently declivous. Femur stout, with much dilated condyles, and with a deep and narrow cavity between the head and trochanters.

3. *Testudo leptocnemis*, sparsely represented, with a scapular similar to that of *T. triserrata*; ossa ilei of moderate length and width, femur slender, with moderately dilated condyles, and with a deep and broad cavity between the head and trochanters.

4. *Testudo boutonii*, known from scapular and humerus only. The former bone is strongly compressed; acromium with the end curved. Coracoid not ankylosed to scapula. Humerus very stout, with the shaft trihedral in its whole length, and without hollow behind the head.

C. The *Rodriguez Tortoise*.—The remains from Rodriguez which I have hitherto examined, and for which I am indebted to M. Bouton and to the trustees of the Glasgow Museum, consist of fragments of the cranium, perfect cervical vertebrae, pelvis, and the larger leg-bones. They indicate one of the best marked species of the entire group, with a double alveolar ridge, and with the neck and limbs of greater length and slenderness than in any other species. The neural arch of the sixth nuchal vertebra is perforated by a large ovate foramen on each side close to the anterior apophyses. These perforations were closed by membrane in the living animal, and evidently caused by the pressure of the apophyses of the preceding vertebra, the animals having had the habit of bringing the neck in a vertical position, so that these two vertebrae were standing nearly at a right angle. Some of the bones are exceedingly large, larger than any of those from the Mauritius, and must have belonged to individuals of the size of our large living male from Aldabra.

II.—ROUND-HEADED TYPE: *T. indica*.

To this type belong all the specimens with a nuchal plate which have been deposited in British collections within the last forty years, or which elsewhere have been described or figured; and more especially the Tortoises from Aldabra. Whether all these specimens have come from this small group is impossible to say, as we know very little or nothing of their history. Although I have succeeded in bringing together a considerable number of specimens, from which it would appear that also in this much smaller division several races could be distinguished, I think it best to defer, for the present, the detailed publication of the results of my examination

which ere long may be supplemented or modified by important accessions.

In conclusion we may ask whether the facts which I have endeavoured to place before the readers of NATURE are more readily explained with the aid of the doctrine of a common or manifold origin of animal forms.

The naturalists who, with Darwin, maintain a common origin for allied species, however distant in their habitats, will account for the occurrence of the tortoises in the Galapagos and Mascarenes in the same way as, for instance, for the distribution of the Tapirs, viz., by the hypothesis of changes of the surface of the globe. Taking into consideration other parts of the Faunæ, they would have to assume, in this case, a former continuity of land (probably varying in extent and interrupted at various periods) between the Mascarenes and Africa, between Africa and South America, and finally between South America and the Galapagos. Indeed, the terrestrial and freshwater fauna of Tropical America and Africa offer so many points of intimate relationship, as to support very strongly such a theory. The Tortoises, then, would be assumed to have been spread over the whole of this large area, without being able to survive long the arrival of man or large carnivorous mammals. The former, especially before he had provided himself with missile weapons, would have eagerly sought for them, as they were the easiest of his captures yielding a most plentiful supply of food; consequently they were exterminated on the continents, only some remnants being saved by having retired into places which by submergence became separated from the mainland before their enemies followed them. With this hypothesis we would be obliged to contend for this animal type an age extending over enormous periods of time, of which the period required for the loss of power of flight in the Dodo or Solitaire is but a fraction.

To my mind the advocacy of an independent origin of the same animal type, however highly organised, in different localities, seems equally justified. It has been urged that closely similar structures of the animal organism have been developed without genetic relationship; so, also, the same complex organic compound, as sugar, is produced normally by the plant and abnormally by the human organism. Without overstepping too far the limits of probability, we may assume that some Land-Tortoises were carried by stream and current from the American Continent to the Galapagos, and that others from Madagascar or Africa, found in a similar manner a new home in the Mascarene Islands. These tortoises may originally have differed from each other, like the *Testudo tabulata*, *radiata*, *sulcata* of our days, possibly not exceeding these species in size, but being placed under the same external physical conditions evidently most favourable for their further development, they assumed in course of time the same gigantic proportions and other peculiarities, the modifications in their structure which we observe now being partly genetic, partly adaptive.

Thus this curious phenomenon in the geographical distribution of animals can be explained by either of those two theories, and does not appear to me to strengthen the position of one more than that of the other. The multiplicity of the races which I have pointed out above I need not further discuss. As regards the Galapagos, this fact is quite in accordance with what has been long recognised in the distribution of the birds of the same archipelago, and the co-existence of several races in Mauritius is perfectly analogous to the variety of species of *Dinornis* in New Zealand.

ALBERT GÜNTHER

NOTES

PROF. SCHÖNFELD, of Mannheim, has been appointed successor to the late Prof. Argelander as Director of the Observatory at Bonn, and will enter upon his duties on Sept. 1. Dr.

Valentiner, chief of the German Astronomical Expedition to Chiefoo, and first assistant at the Leiden Observatory, will succeed Schönfeld at Mannheim.

THE biennial general meeting of the essentially International Astronomical Society will be held at Leiden from the 13th to the 16th inst.

THE Professorship of Natural History at the Newcastle College of Physical Science, vacated by the removal of Dr. Alleyne Nicholson to St. Andrews, has been filled by the appointment of Mr. George S. Brady, of Sunderland. The chair has hitherto been held in conjunction with the Lectureship on Physiology in the Durham University College of Medicine, in Newcastle, a union which it has been found expedient to abolish. The appointment we now record will be regarded with satisfaction by every one who is desirous of seeing the value of the labours of our working naturalists duly recognised in the localities where they have carried on their work.

THE Natural History Society of Newcastle, one of the best in the kingdom, appears to be going through a crisis. At a recent meeting, several of the honorary curators sent in their resignations, including names so well known as H. B. Brady, G. S. Brady, H. B. Bowman, Lebour, and Freire-Marreco, together with both the secretaries. We understand that an informal meeting has been held by a number of those interested in the systematic teaching of natural history, to take steps for obtaining specimens to form an independent typical collection for the use of the professors of the College in their lectures. This is as it should be. Collecting for mere collecting's sake is no part of science; as an adjunct to systematic teaching it is invaluable. A great centre like Newcastle should possess such a collection formed for such a purpose; and the effort is worthy of support and assistance from all friends of science teaching.

AT the distribution of prizes to the Taunton College School by the High Sheriff of Somerset on July 29th, the headmaster, Mr. Tuckwell, commented severely on the exclusion of science from the competition of the Huish Scholarship, to which we drew attention in these columns some weeks ago. The High Sheriff said that he was one of the Trustees who had prepared the scheme; that, looking to the Founder's expressed desire to forward the study of theology, they had wished so to shape the examination as to carry out his views; but that the Trustees were not a bigoted body, nor unduly wedded to their first opinion; that Mr. Tuckwell's criticisms deserved attention; and that he promised on behalf of the Trustees to reconsider the arrangements before another year. In thanking the High Sheriff for the liberal tone in which he had met the questions raised, Mr. Tuckwell protested against the belief that a divine worthy of the name could be trained in the present day by any system of education which should exclude a deep knowledge of science.

M. MOUCHEZ, the new member of the Academy of Sciences, has just organised a Practical School of Astronomy at Montsouris. Refractors, equatorial as well as meridian, and horizontal telescopes will be placed at the disposition of any competent person wishing to be instructed in astronomy. An astronomer from the National Observatory will instruct the pupils without fee; the Minister of Marine has ordered that two marine officers should always be in attendance for this purpose. The course of instruction will embrace celestial photography and spectrum analysis. No qualification of nationality will be required for admittance, only general competency.

M. WURTZ, Professor in the Faculty of Medicine of Paris, has been appointed Professor in the Faculty of Sciences.

THE French Association for the Advancement of Science commences its sittings at Nantes this day week.

M. LE VERRIER has presented to the Prefect of the Seine a plan for connecting, by means of a telegraphic network, all the public clocks of Paris with the principal clock of the Observatory.

THE British Medical Association brought its Edinburgh meeting, which has been a very successful one, to a close last Friday. Brighton has been selected as the place of meeting for next year, with Sir J. Cordy Burrows as President-elect.

It turns out that in the recent attack on the Palestine Exploring party, there were nine wounded, including Lieutenants Conder and Kitchener. Measures have been taken to secure the arrest and punishment of the assailants.

It appears from a letter in Friday's *Times* that that most interesting relic of antiquity, "Caesar's Camp" at Wimbledon "is being deliberately levelled to the ground, effaced and destroyed by its owner, Mr. Drax, the member for Wareham." It is difficult to believe in an act of such deliberate vandalism. Mr. Drax is stated to have asked such an exorbitant price for the land that negotiations were rendered impossible; had Sir John Lubbock's "Ancient Monuments Bill" been passed this session, this evidently doomed and unreplaceable monument of antiquity could easily have been saved, and the owner would have received a fair price for his land.

M. WILFRID DE FONVIELLE made a successful night ascent on August 1, for the purpose of observing meteorites. From 10 P.M. to 4 A.M., forty-two meteorites were observed between Rheims and Fontainebleau. Some of these emanated from Cassiopeia, others from Perseus, and as many as nine took a vertical direction, descending from the part of the heavens which was concealed by the balloon. None of these were very noteworthy, and it is probable that none would have been observed at the surface of the earth. Eight persons were in the car, and another trip was to be made last Sunday from Paris.

THE International Geographical Exhibition is not the only one of the kind now open in Paris; as our readers no doubt know another has been established by M. Nicolle at the Palais des Champs Elysées for Fluvial and Maritime Industries, and is attracting an immense number of visitors. It will continue up to the month of November, when another will be opened for Electrical Industries. The English Section in the Fluvial and Maritime Exhibition is very successful. The Board of Trade has sent specimens of the apparatus in use for salvage and for warnings at British seaports; the contributions by private individuals also give a fair idea of British Maritime Industries.

ON Saturday last a deputation from the Royal Colonial Institute waited upon Lord Carnarvon to urge upon Government the propriety of establishing a Colonial Museum in London. The Government, it seems, have been entertaining the idea of establishing such an institution, and Lord Carnarvon spoke hopefully of the possibility of accomplishing the praiseworthy object; he thinks it would be well to place it contiguous to the India Museum.

A CORRESPONDENT of the *Illustrated London News* of Aug. 1, writes, July 25, from Pen-y-Gardden, Denbighshire, describing a shower of hay similar to that referred to in last week's *NATURE*, p. 279, as having occurred at Monkstown. It passed over the town of Wrexham, five miles distant from Pen-y-Gardden, and in a direction contrary to that of the wind in the lower atmosphere.

MR. MAGNÚSSON, writing to yesterday's *Times*, reports the continued outbreak of volcanic eruptions in various parts of Iceland, and makes an earnest appeal to the British public for help to those, and they are many, who have been rendered quite destitute—landless and homeless—by the calamity. No people are

more deserving of help than the Icelanders, and moreover, they have the claim upon us of close kindred.

We have received the "Fourth Report of the Meteorological, Magnetic, and other Observatories of the Dominion of Canada for 1874," pp. 316. The Report gives full details of the tri-daily observations made at the various meteorological stations, the monthly means and extremes, and, as regards temperature and rainfall, a comparison of the results of 1874 with the averages of previous years. The most important fact perhaps noted in the Report is the gradual extension of the system over British North America.

FROM a letter from the Canada correspondent of *The Scotsman*, dated 23rd July, 1875, we learn that the summer in Canada has been unusually cold. The nights have been quite chilly so as to necessitate extra covering; and during the whole summer the temperature has only once reached 90°; on the evening of the 18th July it fell to 43°. Capt. Richardson, of the *Nova Scotian*, which had just arrived, reports having passed a large number of icebergs on the coast, and having sailed through floating ice for twenty-four hours. Reports from the extreme north state that the ice had given way to a greater extent than for many years, in which case the Arctic Expedition will probably reach a higher latitude before the summer closes than was expected.

IN the *Bulletin Hebdomadaire* of the Scientific Association of France it is stated, after a careful review of the loss sustained by the different districts, that the total loss caused by the late inundations in the South of France exceeds the enormous sum of eighty millions of francs, and that 550 persons perished.

THE June number (just issued) of the *Bulletin* of the French Geographical Society contains an interesting chart of the world, by M. Malte-Brun, intended to exhibit at a glance the proportion of the known and unknown regions. Countries known in their details are wholly covered with red, and those of which we have a good general knowledge, with red having a slight dash of white. White, with specks of red, indicates countries imperfectly known, while those entirely unknown are left in white. Of course the various shades of red run into each other, but countries unknown and imperfectly known considerably exceed in extent the two other classes, so that there is little danger of exploring and surveying parties wanting work for many years to come. The greater part of Asia and America comes under the two last categories, as also nearly the whole of Africa and Australia; indeed, notwithstanding all that has recently been done in the way of geographical discovery, the white at least balances the red in Malte-Brun's chart.

THE same number of the *Bulletin* contains a valuable illustrated paper, by M. L. Chambeyron, giving some details concerning the physical geography of New Caledonia.

THE *Geographical Magazine* states that the committee of the statistical section of the Russian Geographical Society appointed to report on a proposition made by MM. Sobolyef and Jansson, to publish a gazetteer of Central Asia, has reported favourably on the subject. They recommend that particular attention be paid to historical geography and ethnology, as statistical data are subject to frequent alterations. The territory to be embraced by the work is bounded on the north by the watersheds of the Ural and Irtysh; on the west coast by the Caspian; on the south by the Elburz, the Hindu Kush, and the Karakorum Range; and in the east by Mongolia. The authorities for every statement made, are to be carefully referred to for future reference, and great care is to be taken with respect to the spelling. A final programme will be laid down by a joint committee of the three sections of the Russian Geographical Society.

THE *New York Tribune* of July 10 contains a [long article, with many illustrations, on Prof. Hall's magnificent collection of fossils, which, at a cost of \$65,000 has been secured for the American Museum of Natural History, at the Central Park, New York.

THE Watford Natural History Society has already taken an established place in the first rank of our local societies and field-clubs. It has not been many months in existence, but already have we received the first number of its neatly printed *Transactions*, containing the following papers:—"The Cretaceous Rocks of England," by J. L. Lobley, F.G.S.; "Notes on the Flora of the Watford District," by Arthur Cottam; and "Notes on the proposed Re-issue of the Flora of Hertfordshire, with Supplementary Remarks on the Botany of the Watford District," by R. A. Pryor, F.L.S.

IN connection with the Sheffield Ladies Educational Association, Mr. Barrington Ward, F.L.S., has recently concluded a successful and well attended series of elementary lectures on Botany. The results of the examinations on the lectures appear to have been highly satisfactory, and to judge from the specimen examination paper sent us, the questions were well calculated to test the real knowledge of the students.

IN Part I. No. 1, for 1875, of the *Journal* of the Asiatic Society of Bengal will be found a very valuable illustrated paper by Major G. E. Fryer, "On the Khyeng People of the Sando-way District, Arakan." Details are given of the habits of the people, with a brief grammar and copious vocabulary of their language.

MR. G. K. GILBERT's preliminary Geological Report contained in Lieut. Wheeler's Report of the work done by his expedition in 1872 in Nevada, Utah, and Arizona, gives a few interesting data bearing on the former glaciation of N. America. About White's Peak, in the Schell Range, Nevada, are the terminal moraines of five or six glaciers that descended to 8,000 feet altitude in lat. 39° 15'. At about the same altitude, and in lat. 39°, are moraines and an alpine lake upon the flanks of Wheeler's Peak, of the Snake Range, Nevada. Old Baldy Peak (N. lat. 38° 18'), near Beaver, Utah, overlooks two terminal moraines, one of which contains a lakelet at an altitude of about 9,000 feet. No traces were seen of a general glaciation, such as the Northern States experienced and the cumulative negative evidence is of such weight that Mr. Gilbert is of opinion that the glaciers of the region referred to were confined to the higher mountain-ridges.

THE same observer shows that the level of what is now Great Salt Lake must at one time have been much higher and its area much greater than it is at present. Former levels are marked by a series of conspicuous shore-lines carried on the adjacent mountain slopes to a height of more than 900 feet. When the waters rose to the uppermost beach they must have covered an area of about 18,000 square miles, eleven times that of the present lake, and a trifle less than that of Lake Huron; the average depth was 450 feet, and the volume of water nearly 400 times greater than now. The lake was diversified by numerous rocky islands and promontories, and its water was fresh. The flooding of the Great Salt Lake valley, Mr. Gilbert believes, marked a temporary climatal change, and was contemporary with the general glaciation of the northern portion of N. America, and with the formation of the numerous local glaciers of western mountain systems; he considers it a phenomenon of the Glacial Epoch. While the general climatal change that caused or accompanied that epoch (depression of temperature, carrying with it decrease of evaporation, if not increase of precipitation) may be adduced as the cause of the inundation of Utah, Mr. Gilbert sees no reason to suppose that the relative humidities of

the various positions of the N. American continent were greatly changed; and this consideration will aid in accounting, he thinks, for the curious fact that the ice in the eastern seaboard stretched unbroken past the fortieth parallel, while under the same latitude in the Cordilleras no glaciers formed below 9,000 feet.

THE third part of the second series of the magnificent work of Mr. William H. Edwards upon the Butterflies of North America has been published by Messrs. Hurd and Houghton, of Cambridge, Massachusetts, and embraces five plates, executed by Miss Mary Peart. The plates represent species of *Papilio*, *Argynnis*, *Apatura*, *Chionebas*, and *Lycena*; all of them being rare and, for the most part, unfigured species, and also many but recently described.

WE have received the *Journal* of the Anthropological Society for April and July, containing in full the papers which have appeared in abstract in our reports of the meetings of the Society. Many of the papers are of great value, and the illustrations, especially those of the Andamanese, are very interesting.

It is rumoured that, on the retirement of Sir Henry James from the directorship of the Ordnance Survey, a post which he has filled during a lengthened period with so much distinction, he will be succeeded by Col. A. Ross Clarke. We congratulate the Government on this selection, just at once to a most meritorious officer and to Science and the State. Col. Clarke's eminence as a mathematician and a geodesist are too highly appreciated wherever those sciences are cultivated, both at home and abroad, to need any comment from us.

THE additions to the Zoological Society's Gardens during the past week include a Manatee (*Manatus americanus*) from Demerara, a Ground Hornbill (*Bucorvus abyssinicus*), a White-thighed Colobus (*Colobus bicolor*) from West Africa, a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, deposited; two Jaguars (*Felis onca*) from America, a Squirrel Monkey (*Saimaris sciurea*) from Brazil, purchased; four Amherst Pheasants (*Thaumalea amherstie*), a Siamese Pheasant (*Euplocamus grallatus*), and two Vinaceous Doves (*Turtur vinaceus*) bred in the Gardens.

PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES*

THE investigation to which this note refers has occupied me, with little intermission, since my former communication in 1869 to the Society, "On the Continuity of the Liquid and Gaseous States of Matter." It was undertaken chiefly to ascertain the modifications which the three great laws discovered respectively by Boyle, Gay-Lussac, and Dalton undergo when matter in the gaseous state is placed under physical conditions differing greatly from any hitherto within the reach of observation. It embraces a large number of experiments of precision, performed at different temperatures and at pressures ranging from twelve to nearly three hundred atmospheres. The apparatus employed is, in all its essential parts, similar to that described in the paper referred to; and so perfectly did it act that the readings of the cathetometer, at the highest pressures and temperatures employed, were made with the same ease and accuracy as if the object of the experiment had been merely to determine the tension of aqueous vapour in a barometer-tube. In using it the chief improvement I have made is in the method of ascertaining the original volumes of the gases before compression, which can now be known with much less labour and greater accuracy than by the method I formerly described. The lower ends of the glass tubes containing the gases dip into small mercurial reservoirs formed of thin glass tubes, which rest on ledges within the apparatus. This arrangement has prevented many failures in screwing up the apparatus, and has given more precision to the

measurements. A great improvement has also been made in the method of preparing the leather-washers used in the packing for the fine screws, by means of which the pressure is obtained. It consists in saturating the leather with grease by heating it *in vacuo* under melted lard. In this way the air enclosed within the pores of the leather is removed without the use of water, and a packing is obtained so perfect that it appears, as far as my experience goes, never to fail, provided it is used in a vessel filled with water. It is remarkable, however, that the same packing, when an apparatus specially constructed for the purpose of forged iron was filled with mercury, always yielded, even at a pressure of forty atmospheres, in the course of a few days.

It is with regret that I am still obliged to give the pressures in atmospheres, as indicated by an air- or hydrogen manometer, without attempting for the present to apply the corrections required to reduce them to true pressures. The only satisfactory method of obtaining these corrections would be to compare the indications of the manometer with those of a column of mercury of the requisite length; and this method, as is known, was employed by Arago and Dulong, and afterwards in his classical researches by Regnault, for pressures reaching nearly to thirty atmospheres. For this moderate pressure a column of mercury about 23 metres, or 75 feet, in length had to be employed. For pressures corresponding to 500 atmospheres, at which I have no difficulty in working with my apparatus, a mercurial column of the enormous height of 380 metres, or 1,250 feet, would be required. Although the mechanical difficulties in the construction of a long tube for this purpose are perhaps not insuperable, it could only be mounted in front of some rare mountain escarpment, where it would be practically impossible to conduct a long series of delicate experiments. About three years ago I had the honour of submitting to the Council of the Society a proposal for constructing an apparatus which would have enabled any pressure to be measured by the successive additions of the pressure of a column of mercury of a fixed length; and working drawings of the apparatus were prepared by Mr. J. Cumine, whose services I am glad to have again this opportunity of acknowledging. An unexpected difficulty, however, arose in consequence of the packing of the screws (as I have already stated) not holding when the leather was in contact with mercury instead of water, and the apparatus was not constructed. For two years the problem appeared, if not theoretically, to be practically impossible of solution; but I am glad now to be able to announce to the Society that another method, simpler in principle and free from the objections to which I have referred, has lately suggested itself to me, by means of which it will, I fully expect, be possible to determine the rate of compressibility of hydrogen or other gas by direct reference to the weight of a liquid column, or rather of a number of liquid columns, up to pressures of 500 or even 1,000 atmospheres. For the present it must be understood that, in stating the following results, the pressures in atmospheres are deduced from the apparent compressibility, in some cases of air, in others of hydrogen gas, contained in capillary glass tubes.

In this notice I will only refer to the results of experiments upon carbonic acid gas when alone or when mixed with nitrogen. It is with carbonic acid, indeed, that I have hitherto chiefly worked, as it is singularly well adapted for experiment; and the properties it exhibits will doubtless, in their main features, be found to represent those of other gaseous bodies at corresponding temperatures below and above their critical points.

Liquefaction of Carbonic Acid Gas.—The following results have been obtained from a number of very careful experiments, and give, it is believed, the pressures, as measured by an airmanometer, at which carbonic acid liquefies for the temperatures stated:—

Temperatures in Centigrade degrees.	Pressure in atmospheres.
0	35.04
5.45	40.44
11.45	47.04
16.92	53.77
22.22	61.13
25.39	65.78
28.30	70.39

I have been gratified to find that the two results (for 13° 09 and 21° 46) recorded in my former paper are in close agreement with these later experiments. On the other hand, the pressures I have found are lower than those given by Regnault as the result of his elaborate investigation (*Mémoires de l'Académie des Sciences*, vol. xxvi. p. 618). The method employed by that distinguished physicist was not, however, fitted to give accurately

* "Preliminary Notice of further Researches on the Physical Properties of Matter in the Liquid and Gaseous States under varied conditions of Pressure and Temperature." Paper read before the Royal Society by Dr. Andrews, F.R.S., Vice-President of Queen's College, Belfast.

the pressures at which carbonic acid gas liquefies. It gave, indeed, the pressures exercised by the liquid when contained in large quantity in a Thilorier's reservoir; but these pressures are always considerably in excess of the true pressures in consequence of the unavoidable presence of a small quantity of compressed air, although the greatest precautions may have been taken in filling the apparatus. Even $\frac{1}{100}$ part of air will exercise a serious disturbing influence when the reservoir contains a notable quantity of liquid.

Law of Boyle.—The large deviations in the case of carbonic acid at high pressures from this law appeared distinctly from several of the results given in my former paper. I have now finished a long series of experiments on its compressibility at the respective temperatures of $6^{\circ}7$, $63^{\circ}7$, and 100° Centigrade. The two latter temperatures were obtained by passing the vapours of pyroxylic spirit (methyl alcohol) and of water into the rectangular case with plate-glass sides, in which the tube containing the carbonic acid is placed. The temperature of the vapour of the pyroxylic spirit was observed by an accurate thermometer, whose indications were corrected for the unequal expansion of the mercury; while that of the vapour of water was deduced from the pressure as given by the height of the barometer and a water-gauge attached to the apparatus. At the lower temperature ($6^{\circ}7$) the range of pressure which could be applied was limited by the occurrence of liquefaction; but at the higher temperatures, which were considerably above the critical point of carbonic acid, there was no limit of this kind, and the pressures were carried as far as 223 atmospheres. I have only given a few of the results; but they will be sufficient to show the general effects of the pressure. In the following Tables p designates the pressure in atmospheres as given by the air-manometer, t' the temperature of the carbonic acid, e the ratio of the volume of the carbonic acid under one atmosphere and at the temperature t' to its volume under the pressure p and at the same temperature, and θ the volume to which one volume of carbonic acid gas measured at 0° and 760 millimetres is reduced at the pressure p and temperature t' :—

Carbonic Acid at $6^{\circ}7$.				
p . at.	t' . °	e .	θ .	
13.22	6.90	$\frac{1}{14.36}$	0.07143	
20.10	6.79	$\frac{1}{23.01}$	0.04456	
24.81	6.73	$\frac{1}{29.60}$	0.03462	
31.06	6.62	$\frac{1}{39.57}$	0.02589	
40.11	6.59	$\frac{1}{58.40}$	0.01754	
Carbonic Acid at $63^{\circ}7$.				
p . at.	t' . °	e .	θ .	
16.96	63.97	$\frac{1}{17.85}$	0.06931	
54.33	63.57	$\frac{1}{66.06}$	0.01871	
106.88	63.75	$\frac{1}{185.9}$	0.00665	
145.54	63.70	$\frac{1}{327.3}$	0.00378	
222.92	63.82	$\frac{1}{446.9}$	0.00277	
Carbonic Acid at 100° .				
p . at.	t' . °	e .	θ .	
16.80	100.38	$\frac{1}{17.33}$	0.07914	
53.81	100.33	$\frac{1}{60.22}$	0.02278	
105.69	100.37	$\frac{1}{137.1}$	0.01001	
145.44	99.46	$\frac{1}{218.9}$	0.00625	
223.57	99.44	$\frac{1}{380.9}$	0.00359	

These results fully confirm the conclusions which I formerly deduced from the behaviour of carbonic acid at 48° , viz. that while the curve representing its volume under different pressures approximates more nearly to that of a perfect gas as the temperature is higher, the contraction is nevertheless greater than it would be if the law of Boyle held good, at least for any temperature at which experiments have yet been made. From the foregoing experiments it appears that at $63^{\circ}7$ carbonic acid gas, under a pressure of 223 atmospheres, is reduced to $\frac{1}{447}$ of its volume under one atmosphere, or to less than one half the volume it ought to occupy if it were a perfect gas and contracted in conformity with Boyle's law. Even at 100° the contraction under the same pressure amounts to $\frac{1}{381}$ part of the whole. From these observations we may infer by analogy that the critical points of the greater number of the gases not hitherto liquefied are probably far below the lowest temperatures hitherto attained, and that they are not likely to be seen, either as liquids or solids, till much lower temperatures even than those produced by liquid nitrous oxide are reached.

(To be continued.)

NEW METHOD OF OBTAINING ISOTHERMALS ON THE SOLAR DISC*

ON June 5, 1875, I devised a method for obtaining the isothermals on the solar disc. As this process may create an entirely new branch of solar physics, I deem it proper that I should give a short account of it in order to establish my claim as its discoverer.

In the American Journal, July 1872, I first showed how one can, with great precision, trace the progress and determine the boundary of a wave of conducted heat in crystals, by coating sections of these bodies with Meusel's double iodide of copper and mercury, and observing the blackening of the iodide where the wave of conducted heat reaches 70° C. If we cause the image of the sun to fall upon the smoked surface of thin paper, while the other side of the paper is coated with a film of the iodide, we may work on the solar disc as we formerly did on the crystal sections.

The method of proceeding is as follows: beginning with an aperture of object-glass which does not give sufficient heat in any part of the solar image to blacken the iodide, I gradually increase the aperture until I have obtained that area of blackened iodide which is the smallest that can be produced with a well-defined contour. This surface of blackened iodide I call the *area* of blackened temperature. On exposing more aperture of object-glass, the surface of blackened iodide extends and a new area is formed bounded by a well-defined isothermal line. On again increasing the aperture another increase of blackened surface is produced with another isothermal contour; and on continuing this process I have obtained maps of the isothermals of the solar image. By exposing for about twenty minutes the surface of iodide to the action of the heat inclosed in an isothermal, I have obtained thermographs of the above areas; which are sufficiently permanent to allow one to trace accurately their isothermal contours. There are other substances, however, which are more suitable than the iodide for the production of permanent thermographs.

The contours of the successively blackened areas on the iodide are *isothermals*, whose successive thermometric values are inversely as the successively increasing areas of aperture of object glass which respectively produced them.

As far as the few observations have any weight, the following appear to be the discoveries already made of this new method. (1) There exists on the solar image an area of sensibly uniform temperature and of maximum intensity. (2) This area of maximum temperature is of variable size. (3) This area of maximum temperature has a motion on the solar image. (4) The area of maximum temperature is surrounded by well-defined isothermals marking successive gradations of temperature. (5) The general motions of translation and of rotation of these isothermals appear to follow the motions of the area of maximum temperature which they inclose; but both central area and isothermals have independent motions of their own.

On projecting the enlarged image of a sun-spot on the blackened surface and then bringing a hot-water box, coated with lamp-black, near the other side of the paper, one may

* The discovery of a method of obtaining Thermographs of the Isothermal Lines of the Solar Disc, by Alfred M. Mayer in *Silliman's American Journal* for July.

develop the image of the spot in red on a dark ground. A similar method probably may serve to develop the athemic lines in the ultra-red region of the solar and other spectra.

OUR BOTANICAL COLUMN

FERULA ALLIACEA.—The late Mr. D. Hanbury was a valuable and frequent contributor to the Kew Museums, and the very last contribution made, or rather bequeathed by him, has a scientific as well as a melancholy interest. The specimen in question was a fine umbel, bearing ripe fruits of *Ferula alliacea*, Boiss., the label to which we believe was written at his dictation just before his death. Seeds of this plant were also received at Kew from him some time before the receipt of this specimen, and these have germinated, and, though healthy, are as yet naturally very small plants. In the "Pharmacographia" Mr. Hanbury refers to this plant as exhaling a strong odour of Asafoetida, but says it is not known as the source of any commercial product. In contradistinction of this, however, Mr. W. Dymock, Professor of Materia Medica at Bombay, writing on the Asafoetidas of the Bombay market in a recent number of the *Pharmaceutical Journal*, says that this plant produces one of the distinct kinds known in the above drug market under the name of "Abushahere Hing," and is brought from the Persian Gulf ports, principally from Abushaher and Bunder Abbas, and is produced in Khorassan and Kirman. The specimens received at Kew from Mr. Hanbury appear to have been first received by him from the author of the paper in question, for he refers to having sent such specimens; therefore, if the specimens are authentic, there is no reason to doubt the truth of the statement made by Mr. Dymock, that the drug which appears in the Bombay Customs Returns as Hing or Asafoetida, is produced by this plant. It arrives in Bombay either in skins sewn up so as to form a flat oblong package, or in wooden boxes. Its appearance varies according to age, being soft, and about the thickness of treacle when quite fresh, and of a dull olive brown colour and a pure garlic odour. It becomes hard and translucent and of a yellowish brown colour after being kept some time. Slices of the root are found mixed with the resin in about equal proportion. In 1872-73 as many as 3,367 cwt. of this drug were imported into Bombay from the Persian Gulf. The information given in the paper from which we have quoted the above particulars seems to be of a trustworthy nature, and will prove a valuable addition to what we already know of the Asafoetidas.

DIVERSE EFFECTS OF THE SAME TEMPERATURE ON THE SAME SPECIES IN DIFFERENT LATITUDES.—In the *Comptes Rendus des Séances de l'Académie des Sciences*, June 1875, Mr. A. de Candolle gives the results of some experiments instituted by himself last winter to determine the degree of influence of heat on the vegetation of the same species under otherwise diverse conditions. The sudden burst into life and the rapid development of the vegetation of northern regions is proverbial; the advent of mild weather seems to bring at once into activity the accumulated vital energies, and growth is exceedingly rapid. In the south the same temperature would have far less visible effect on the same species. De Candolle has attempted by direct experiment to ascertain to what extent this influence is exercised. For this purpose he procured specimens of several common deciduous trees from Montpellier, and submitted them to the same temperature as, and with, specimens of the same species collected at Geneva. In the ordinary course of things the same species came into leaf from three weeks to a month earlier at Montpellier than at Geneva, but the specimens from the south, by the side of the northern specimens, did not unfold their leaves so early as the latter by about three weeks. The White Poplar Hornbeam and Tulip Tree were the principal trees employed. Catalpa, a very late leafing subject, exhibited less diversity in this respect. This phenomenon is equally striking in cereals and other cultivated plants. The learned author attributes these differences in effect mainly to the fact that vegetation, or external growth, never entirely ceases in the south, whereas in the north there is a long period during which internal changes and modifications of substances alone is carried on.

SCIENTIFIC SERIALS

The American Journal of Science and Art, July.—The original articles are:—On the United States Weather Map, by E. Loomis, which we have already noticed.—On a magnetic proof

plane, by H. A. Rowland. The apparatus required is a small coil of wire $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter and containing 10 to 50 and a Thomson galvanometer. Having attached the small coil (or magnetic proof plane, as Mr. Rowland calls it) to the galvanometer, it has to be laid on the required spot and then suddenly pulled away and carried to a distance, and the momentary deflection of the galvanometer will be proportional to that component of the lines of force at that point which is perpendicular to the plane of the coil. By a coil of this kind it is possible to determine the intensity of the magnetic field at any point, and thus be able to make a complete map of it. Illustrations of the method are given.—On pseudomorphs of chlorite after Garnet at the Spurr Mountain Iron Mine, Lake Superior, by Raphael Pumpelly, with a coloured plate of a section magnified $\frac{25}{2}$.—A brief note on the application of the horizontal pendulum, by Harcourt Amory.—Explosive properties of methyl nitrate, by Carey Lea. This communication describes a new method and the requisite apparatus for preparing it, so that danger is reduced to a minimum.—On zonochlorite and chlorastrolite, by G. W. Hawes.—On glycogen and glycocoin in the muscular tissue of *Pecten irradians*. The glycogen has the formula of the sugars of that of the starch group plus a molecule of water. The amount of glycocoin occurring in the tissue is small. Analyses are given.—On Dr. Koch and the Missouri mastodon, by Edmund Andrews. The object of the article is to show that Dr. Koch's testimony contributes nothing reliable on the question of the occurrence of human remains in conjunction with the mastodon.—On the rate of growth of corals, by Prof. Joseph Le Conte. Examining a grove of madrepores he noticed that all the prongs grew to the same level, which at the time were very near the surface; and that all of them were dead at the tips for about three inches. The varying level of the ocean at the place is known from the Coast Survey Report, and as it seems that during the high water the madrepores grow up, the living points of the madrepores grow up till the descending water-level exposes and kills them down to a certain level; with the rise of the mean level again new points start upwards. The annual growth, calculated from the known rise and fall of water level, is from $\frac{3}{4}$ to 4 inches per annum.—Results of dredging expeditions off the New England Coast in 1874, by A. E. Verrill. Lists of species are given.—Examination of gases from the meteorite of Feb. 12, 1875, by A. W. Wright.—Discovery of two new asteroids, 144 and 145, by C. H. Peters. The diameter of 144 is as the 10th, and 145 as 11th.—The discovery of a method of obtaining thermographs of the isothermal lines of the solar disc, by Alfred M. Mayer. We reprint the paper this week.

Jahrbücher für wissenschaftliche Botanik. Herausgegeben von Dr. N. Pringsheim. Band x. Heft 1. (Leipzig, 1875).—In the first part of the tenth volume of Pringsheim's well-known *Jahrbuch* we have three papers all of very considerable importance. The first is a translation of Count Francesco Castracane's paper on the Diatomaceæ of the Carboniferous period. Ashes of coal from Liverpool yielded, on microscopic examination, several species of Diatomaceæ. The chief forms identified by Count Castracane all belong to fresh-water genera and species, viz.:—

Fragilaria Harrisonii, Sm.
Epithemia gibba, Ehrbg.
Sphenella glacialis, Kz.
Gomphonema capitatum, Ehrbg.
Nitzschia curvula, Kz.
Cymbella Scotica, Sm.
Synedra vitrea, Kz.
Diatoma vulgare, Bory.

In addition to these there existed a *Grammatophora*, a small *Coscinodiscus*, and probably an *Amphipleura (danica?)*. These three marine forms were only observed on one occasion, and their presence must have indicated some accidental inroad of sea-water among the vegetation from which the piece of coal was formed. All the fresh-water forms which occurred in the coal are not to be distinguished from the living forms of the same species, a fact of great interest and importance, as it indicates the remarkable permanence of these forms in time; and it is probably an unique instance of the occurrence of species which have remained unmodified through all the lapse of ages which separates the present epoch from the coal period. Count Castracane examined other varieties of coal besides that obtained from near Liverpool, viz., coal from the mines at St. Etienne, another from Newcastle, and a third specimen

of the Scotch "Cannel coal." In all these *fresh-water* diatoms were found to be more or less numerous. The three specimens yielded different species of Diatomaceæ, but no new forms were detected. The coal for examination was finely pulverised, then placed in a piece of combustion tubing and heated to redness, a gentle stream of oxygen being passed over the substance. The temperature must not be raised too high, in order not to fuse the siliceous skeletons of the Diatomaceæ. The residue is to be treated with nitric acid and chlorate of potash, and heated, then washed carefully with distilled water, and mounted in the usual way. The examination of other varieties of coal would no doubt yield results of the highest interest and importance.—The second paper, "Beiträge zur Theorie der Pflanzenzelle," is by Dr. J. Tschistiakoff, and is devoted to the development of the pollen of *Epilobium angustifolium*. The chief point in the paper is the description of the pro-nucleus, which is also to be met with, according to Tschistiakoff, in the spores of Cryptogams. In the mother-cells of the pollen-grains the protoplasm becomes differentiated into certain zones or regions, one called the pro-nucleus, which contains the nucleolus. The pro-nucleus becomes more differentiated during the growth of the cell, and may divide or disappear. When new pro-nuclei are formed, one ultimately becomes developed into the true nucleus of the cell. The paper is illustrated by five plates.—The last paper is upon the development of the Prothallium of the Cyatheaceæ, by Dr. Hermann Banke. The species chiefly examined were: *Cyathea medullaris*, *Alsophila australis*, and *Hemitelia spectabilis*. The paper treats of—1. The germination of the spore and the development of the Prothallium; 2. The development of the Antheridia; 3. Development of the Archegonia and Fertilisation; 4. Male Prothallia and proliferation of Prothallia; and 5. Anomalies. The general results of the paper show that in most points the development of the Prothallium of the Cyatheaceæ agrees with that of the Polypodiaceæ. A special peculiarity is the occurrence of one rarely of two, stalk-like cells to the Antheridium. The subject is exhaustively treated, and it is illustrated by five plates.

Reichert und Du Bois-Reymond's *Archiv für Anatomie, Physiologie, &c.*, 1875. No. 1, May.—On the Pronation and Supination of the forearm, by Hermann Welcker, Halle. The author believes that the motions of pronation and supination should be regarded not merely as movements of rotation, but also as hinge-movements about an axis passing through the middle of the head of the radius and the styloid process of the ulna. For the term "extreme supination" he would substitute dorsal flexion of the radius; for "pronation," volar flexion of the radius. The actions and positions of the muscles concerned are carefully analysed, and diagrams are given illustrating and supporting the view taken.—Another paper by the same author discusses the effect of the ileo-tibial tract of the fascia lata.—In a paper on the partial excitation of nerves, Hermann Munk gives a *résumé* of his previous papers on the various effects produced on the fibres of nerves according to their situation with respect to the electrodes used, and attributes the contradictory results attained by Rollett and Bour, who believe in a difference of functional irritability in different nerve-fibres, to their having used induction-currents, while he had used constant currents in his experiments.—Dr. Dönhoff points out that calves born early in the year have a longer and thicker coat of hair than those born later in the season; and that this occurs indifferently whether the mother is kept in the stall all the year round, or only passes the winter in the stall.—Dr. Wenzel Gruber, of St. Petersburg, describes a case of the occurrence of the lateral tuberosity of the fifth metatarsal bone as a distinct epiphysis, and two cases of epiphyses on the tubercle of the trapezium.—Dr. von Ihering, in a paper on the temporal ridges of the human skull, supports Hyrtl's description of two temporal ridges, of which one or other is usually better developed. He comes to the conclusion that the upper ridge is related to the temporal fascia, and the lower to the limit of the temporal muscle, and that the temporal ridges in man correspond accurately with those of the anthropomorphic apes. He figures skulls of a Paumotu Islander and of a Hungarian in the Göttingen Museum, as instances of remarkably prominent temporal ridges.—Dr. Albert Adamkiewicz, of Königsberg, contributes a remarkable paper on the analogies to Dulong and Petit's Law of Specific Atomic Heat in Animal Temperature. He conducted an elaborate series of experiments to determine the influence of the surrounding temperature and the size of the body on the specific temperature of the animal, and to discover the physical explanation of the results attained by physiological experiments

on temperature. The paper extends over nearly seventy pages, and it is impossible here to do more than indicate the subject of inquiry.

No. 2, July.—This number, in addition to the conclusion of the last-named paper, contains another by Dr. Adamkiewicz on the conductivity of muscle for heat. The conclusion drawn from experiment is that on a scale representing the conductivity of copper as 1000, water as 1.4, and that of air as 0.05, the conductivity of muscle is represented by 0.6.—J. Steiner, of Halle, gives the results of experiments with curare on fishes, newts, molluscs, starfishes, holothurians, and medusæ. He finds that in fishes there is paralysis of the central organ of voluntary motion, of the respiratory centre, and of motor nerves, and that the times at which the effects appear are in the order named. The period at which paralysis of motor nerves sets in, is much later than in higher vertebrates. In the electrical rays the power of the electrical nerves remains much longer than that of motor nerves. In crabs the phenomena are similar to those in fishes, but they appear still later. In molluscs, starfishes, and holothurians, there is only a paralysis of the central organ of voluntary motion. Curare appears to have no effect on medusæ.—Fanny Berlinerblau describes a case of direct transition from arteries to veins in the human subject.—E. Tiegell gives an account of the physiological effect of a capillary electrical current.—Dr. W. Gruber has four papers—(1) on the occurrence of a second zygomatic bone in man; (2) on the pso-hamatus muscle; (3) on an anomalous extensor digitorum communis in the hand, and a similar anomaly in the extensor digitorum longus in the foot; and (4) on the flexor pollicis longus.—W. Krause figures a human embryo at about the fourth week, with a pear-shaped allantois.—E. Meyer gives an account of comparative investigations in the mammalia on the cause of the pale or red appearance of striated muscles, and concludes that the shade of colour varies with the work done by them.—Prof. Aebly, of Berne, has a paper on the sesamoid bones of the human hand.

THE *Geographical Magazine*, August.—In connection with Lieut. Cameron's explorations, Mr. C. R. Markham takes occasion to give an interesting *résumé* of the history of the discovery of the course of the Congo, and strongly advocates that relief should be sent out to Cameron.—An interesting sketch follows of the journey of Chekanovski and Müller to the Siberian river Olenka (Olenek), in 1873-74; this is illustrated by a sketch-map.—The number also contains a large sketch-map of the countries between Kashmir and Panjikirah, including Chilas, Kandia, and other districts of Dardistan, compiled by Mr. Ravenstein from the most trustworthy recent sources.—"Signposts on Ocean's Highway.—The Physical Education of Dust.—Mountains," is the title of an article by Mr. H. P. Malet.

SOCIETIES AND ACADEMIES

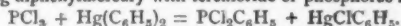
VIENNA

Imperial Academy of Sciences, April 1.—On cold mixtures, with special reference to those consisting of snow and sulphuric acid, by Prof. Pfander.—On palæogeological geography, by Dr. A. Boué.—On the carboniferous lime fauna of the Barents Isles (in the N. W. of Novaya Zemlya), by Dr. F. Toula; this interesting paper contains a list of no less than one hundred different species found in that remote locality.

April 15.—The following papers were read:—On anomalous dispersion, by Prof. E. Mach.—On a new direct proof for the rotation of the earth, by F. v. Sedlmayer Seefeld.—On the generating of nitrogen from the albuminoid matter undergoing assimilation in the body, by Prof. J. Seegen and Dr. Nowak.—On an apparatus for the determination of the mechanical equivalent of heat, by H. J. Puluj.—On the orbit of Planet (III.) Ate, by Director von Littrow and Dr. Holetschek.—On the variability of diurnal temperatures, by Dr. J. Hann.—On the function of lime with germ-plants of *Phaseolus multiflorus*, by Prof. J. Boehm.—Several papers of minor interest.

BERLIN

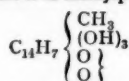
German Chemical Society, July 12.—A. W. Hofmann in the chair.—A. Borodin, in treating an amarine salt with nitrite of potassium, has obtained a nitrosoamarine. He concludes amarine to be an imidobase.—A. Michaelis and F. Graeff have discovered a new mode of formation of phosphenylic chloride, by treating diphenylmercury with trichloride of phosphorus:



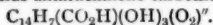
J. V. Janowsky published new analyses of the mineral Cronsted-

tite.—A. Kundt and E. Warburg have investigated the specific heat of the vapour of mercury. Their reason for doing so was the exception shown by most vapours with regard to the kinetic molecular theory of Clausius. If c signifies the specific heat of a gas of constant volume, and c' the specific heat of the same gas at constant pressure: then $\frac{c}{c'}$ according to that theory should be $= 1.67$, while most gases have been found to possess the coefficient $= 1.405$. Mercury-vapour affords a particular interest, because its molecule is monatomic compared with those diatomic volumes of most other gases. It was found to coincide with the law of Clausius $\frac{c}{c'}$ having been found 1.67.—A. Schüller and V.

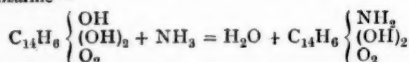
Wartha described a new ice-calorimeter, a modification of Bunsen's instrument which offers the facility of applying ice which is not entirely pure.—F. Beilstein, as also A. Claus, described derivations of dichlorobenzoic acid.—R. Gnehm described derivatives of diphenyl-amine.—V. Meyer and Lecco have treated iodide of tetramethyl-ammonium with iodide of ethyl, and also iodide of tetrachlammonium with iodide of methyl, without observing in either case an exchange of ethyle against methyl.—W. Klobukowsky and E. Nölting have made researches respecting the constitution of rufigallic acid, which lead them to adopt the formula formerly described by M. Jaffé.—Ph. Zöller and E. A. Grete have added some new observations on xanthogenic salts as a remedy against Phylloxera. Amylic xanthogenate appears to be as efficacious as the corresponding ethylxanthogenate. Amylxanthogenate of potassium can be prepared in Vienna at the price of 3*l.* a hundredweight.—C. Liebermann has submitted emodine, the substance accompanying chrysophanic acid in the root of rhubarb, to new researches. He considers it as methylpurpurine—



By oxydation it yields anthrachinone-carbonic acid—



Heated with powdered zinc, emodine yields anthracene.—C. Liebermann and E. Fischer have transformed purpurine into amidolazirine—



This body, by the action of nitrous acid, gives an isomerid of alizarine, viz., purpuroxanthine.—A. Pinner found chloracrylic acid to be transformed by water into malonic acid.—H. Gabriel has studied the body called ammelide by Gerhardt, and has found the formula $(\text{C}_3\text{N}_3)\text{NH}(\text{OH})_2$ predicted by this chemist.—P. Meyer has prepared a number of derivatives of glycolcol, containing phenyl or tolyl and chlorine, obtained by the action of aniline and toluidine on the chloride of chloracetic acid. He likewise has studied the action of those bases on the ether of chloracetic acid.—C. L. Jackson has found in the residues of aniline obtained from a German manufactory a base homologous with xenylamine, viz., $\text{C}_{13}\text{H}_{13}\text{N} = \text{C}_{13}\text{H}_{11}\text{NH}_2$. The radical being most likely, tolylphenyl.

PARIS

Academy of Sciences, Aug. 2.—M. Frémy in the chair.—The following papers were read:—On the magnets formed of compressed powders, by M. J. Jamin.—Memoir by M. N. Joly, entitled: A gap in the teratological series filled up by the discovery of the genus "Hedaphia."—On neutral substrata, by M. Weddell. This paper relates to another one read by M. Contejean at the meeting of July 19, with reference to botanical geography.—A critical examination of the basis upon which the calculus generally used to estimate the stability of bridges with metal supports and straight prismatic beams, is based; with propositions for the adoption of a new basis, by M. Lefort.—On the integration of an equation with partial differentials of the second order, by M. N. Nicolaides.—On the recurrent sensibility of the peripheral nerves of the hand, by M. A. Richet.—Researches on the nodules of oligoclase in the lava of the last eruption of Santorin, by M. F. Fouqué.—On the method of buying beetroot by the density of their juice, by M. Durin.—On microzymata and their functions in the different ages of one and the same being, by M. J. Bechamp.—A new process for the determination of free oxygen in urine, by M. D. Freire.—

Observations by M. Blanchet, on the project of creating a sea in the interior of Africa.—A memoir by M. P. Maille, on cyclones. On the variations in the brilliancy of Jupiter's fourth satellite, with deductions regarding its physical constitution and its movement of rotation, by M. Flammarion. The author states the following results of his observations: The IV. satellite of Jupiter undergoes considerable variations in its brilliancy and appears to us as a star between the 6th and the 10th magnitudes. As its phases as seen from the earth are hardly perceptible, we conclude that its physical constitution is absolutely different from that of the moon. There is a probability (but no certainty) in favour of the hypothesis that it revolves like the moon, presenting always the same face to the planet. In that case, its brightest hemisphere would be that which it turns towards the sun when on the superior western quarter of its orbit, and its darkest hemisphere the one it turns towards the sun when it stands in the lower eastern quarter of its course. This hypothesis does not account for all the variations observed, and this little world seems to undergo atmospherical revolutions which cause its reflecting surface to vary at any point of its orbit. It appears sometimes nebulous and dim. Its reflecting power is as a rule inferior to that of the three other satellites of Jupiter. —On molecular combinations by M. C. Friedel.—On the complete separation of arsenic from animal matter and on its determination in the different tissues, by M. Arm. Gautier.—On the determination of glucose in wine, by M. A. Bechamp.—On the breaking off of the teats of guinea-pigs, by M. de Sinety.

BOOKS AND PAMPHLETS RECEIVED

BRITISH.—Proceedings of the Liverpool Naturalists' Field Club, 1874-75.—The Celt, the Roman and the Saxon: Thos. Wright, F.S.A. 3rd edition, revised (Trübner and Co.)—Proceedings of the Bristol Naturalists' Society, N.S., Vol. i. Part 2.—Jenkinson's Practical Guide to Carlisle, Gilsland, Roman Wall, &c. (Stanford); and smaller edition of above.—Rocket Floats and Rocket Rams: Chas. Meade Ramus (Stanford).—A Practical Treatise on the Diseases of the Eye: Haynes Walton, F.R.C.S. (J. and A. Churchill).—The Annual Address of the Victoria Institute: Rev. Robert Main (Hardwicke).—Our Summer Migrants: J. E. Harting, F.L.S., F.Z.S. (Bickers and Son).

FOREIGN.—Schriften der Naturforschenden Gesellschaft in Danzig. 3. Band, 3. Heft.—Notes sur des Empreintes d'Insectes Fossiles: A. P. de Borre (Brussels, De Veuve Nys).—Sitzungsberichte der Gesellschaft der Wissenschaften in Prag. 1874.—Grundzüge einer Theorie der Cubischen Involuntionen: von Emil Weyr (Prag).—Zur Lehre der Parallel Projection und der Flächen: von Prof. Dr. W. Matzka (Prag).—Shidiern im Gebiete des Kohlengrubes von Böhmen: von Mdr. O. Teismantel (Prag).—Das Jeokline Krystallsystem: von J. Krejzl.—Ueber die Chemische Konstitution der "Natürlichen chlor- und fluor-haltigen Silikate": von Dr. A. Safarik (Prag).—Mémoires de la Société des Sciences de Liège. Second Series, Vol. iv. (Brussels).—Die Periodischen Bewegungen der Blattorgane: von Dr. W. Pfeffer (Leipzig, W. Engelmann).

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